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ABSTRACT

This manual provides information on preventive treatment and improving the health and food of infants, young children, and their mothers in developing nations. The nutrition needs of women during and following pregnancy are outlined, as well as the benefits and problems of breast feeding and weaning techniques. A discussion is presented on the major causes of disease and death in children under five years old in developing countries. The availability, nutritional value, and preparation of foods in tropical and semitropical climates is the subject of the last nine chapters. (JD)

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PROTEIN-CALORIE ADVISORY GROUP
OF THE UNITED NATIONS SYSTEM

UNITED NATIONS
NEW YORK, 10017

# Manual on Feeding Infants and Young Children

SECOND EDITION

**Margaret Cameron and Yngve Hofvander**

U S DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

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## PREFACE TO THE SECOND EDITION

This is a new edition of an already well-established PAG publication—*Manual on Feeding Infants and Young Children*. The first edition (English only) issued in offset in September, 1971, was in great demand, particularly from health professionals and auxiliary workers in many developing countries and health and nutrition training institutions. It was found useful in practical field nutrition work programs.

After the Manual had been used in the field for four years, a number of practical suggestions for changes were received. Miss Margaret Cameron and Dr. Yngve Hofvander, the authors, agreed to revise the publication, incorporating those suggestions in this second edition. The revision also has provided an opportunity to update some information, to provide details on a few points, and to emphasize certain specific factors. The additions and changes are reflected in the modification of some chapters and the rewriting of some others. Certain tables and figures have been deleted and new ones added.

Because of the great demand for the Manual in French- and Spanish-speaking countries, the second edition is being issued in English, French, and Spanish languages. It is hoped that the Manual will continue to improve the knowledge and develop the skills needed in both the home and the community, and will help to foster sound and proper infant- and child-feeding practices.

PAG Secretariat
1st December 1976

* * *

## PREFACE TO THE FIRST EDITION

This manual is published under the auspices of the FAO/WHO/UNICEF Protein Advisory Group (PAG). When establishing its *ad hoc* Working Group on Feeding the Preschool Child, the PAG felt that the Group should examine the nutritional problems of the young child with special emphasis on homemade weaning foods.

The Group was pleased to obtain the services of Miss Cameron and Dr. Hofvander. Miss Cameron has a degree in Home Science and has had postgraduate dietetic training. She holds a position as principal lecturer in nutrition and dietetics at the Northern Polytechnic in London. Previously, Miss Cameron was for some years at the Department of Human Nutrition at the London School of Hygiene and Tropical Medicine where she worked with the late Professor Platt. Teaching contacts over a number of years with students in nutrition from all over the world, together with practical training in tropical countries, has provided rich material for this manual. Miss Cameron has also been a consultant to WHO. Dr. Hofvander is a paediatrician with long experience in Africa, first as resident of the Ethio-Swedish Pediatric Clinic in Addis Ababa and later as Director of the Children's Nutrition Unit, now the Ethiopian Nutrition Institue, in the same city. On a number of occasions Dr. Hofvander has been a consultant to WHO. He is presently a full-time consultant to the Swedish International Development Authority (SIDA).

In developing countries the mortality among preschool children is extremely high, often ten to twenty times higher than in industrialized countries. It is quite clear that malnutrition, often in combination with infection, plays a leading role in this connection. As long as successful breast feeding continues the child is reasonably well protected, but once this unique food is no longer available in sufficient amounts the child enters a very precarious period of its life. The traditional society rarely has special weaning foods which are suitable for the purpose and adult food is usually quite inadequate for the needs of the young, fast-growing child.

In recent years great efforts have been made to stimulate production in developing countries of low-cost protein-rich foods to be used primarily as supplements during and after the weaning period. This is very laudable and attempts of this kind should be encouraged in every way. However, for a long time to come such products will in most countries reach only a small segment of the child population.

The only avenue open for the vast majority of the children is to find better uses for the locally available staples for preparation of nutritious weaning foods in the home. It is the main purpose of this book to give comprehensive information related to such homemade weaning foods. In addition, it provides information concerning the normal growth of the child, its nutritional needs, and the fundamental importance of breast feeding as a lifesaving measure during early life.

The topics just mentioned are by no means new; they have been dealt with by other authors and at various conferences and seminars, sometimes at considerable length. However, much of the material, especially information on homemade weaning foods, is in the form of mimeographed documents which are often hard to obtain. This may explain why comparatively little of this information has found its way into standard textbooks for nurses, doctors and other professionals. Also, education on homemade weaning foods has been looked upon as a simple thing which could be left entirely in the hands of people without much training. This is a serious mistake since health personnel working in this field require much more training and knowledge, both theoretical and practical, than do those who are engaged in giving shots of penicillin or vaccine.

The manual is intended primarily for professional groups who have some basic knowledge of nutrition, child health, home economics, etc., i.e. physicians, nurses, teachers and also nutritionists and home economists without specific experience in the field of young child nutrition. With the basic information provided it should be possible to prepare simple material for teaching in the local language. A special section of the manual is devoted to practical advice on how such a "translation" could be executed.

Basic in all applied programmes, whether in nutrition or not, is the economy involved. It is of major importance that homemade weaning foods involve little or none of the cash economy as far as farmers and tenants, who are cultivating their own crops, are concerned. For the city dwellers, who have to buy part or all of the ingredients, the recipes provided in this manual aim at keeping ingredient and production costs low. It is essential that the homemade foods should be considerably cheaper than even the "low-cost" commercial foods.

The authors invite readers to send their comments and proposals for improvements of the manual. They will be considered seriously if and when a new edition is prepared. Such comments and proposals might also be sent to the PAG Secretariat, address:

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New York 10017
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Bo Vahlquist
Chairman of the PAG *ad hoc* Working Group
"Feeding the Preschool Child"
September 1st, 1971

# INTRODUCTION

This manual is designed to help those who are involved in any way in the fields of health and nutrition. Its aim is to provide an appropriate, useful, and practical background of knowledge that explains why preventive treatment and improvement in the health and the food of infants, young children, and their mothers is necessary, and how this may be achieved.

The target group of readers includes both medical personnel and all those to whom they delegate responsibility: medical assistants and students; nurses and midwives; nutritionists; dietitians; home economists; and senior personnel in the fields of community development and agriculture. It is hoped that they will act as interpreters of the information in this manual, disseminating it in the most practical way at each level, until it reaches the auxiliaries who work with mothers in either rural or urban communities.

The factors that affect normal growth and development, and simple methods of measuring them, are discussed. An account of the nutrient contributions of various foods and an explanation of the principles on which the recommended food combinations have been based are included. These principles can be applied to the foods that normally are used and are readily available in each community.

All diets, especially those for infants and young children, must meet known needs for energy and all nutrients, including protein. The bulk of a diet is also important, and must be considered in relation to its consumer.

The technical terms currently used in FAO/WHO reports have been adopted here. Consequently, the term *energy* has replaced *calories*, except for quantitative measures. Because of their traditional familiarity, these continue to be described as kilocalories, whose relationship to the newer terminology is explained.

In 1973, the Joint FAO/WHO Expert Committee suggested a new pattern of amino acids for human requirements as a reference for "scoring" protein quality, but stressed it was based on incomplete information. However, workers who have used this pattern have found that it does not agree well with measurements made biologically, so it has not been adopted in this revision. Many questions remain to be answered, particularly in regard to an individual's need for energy and protein.

In most tropical countries, the population is predominantly rural, and many people live on a subsistence economy. For those in urban areas who have recently changed to a market economy, the level of income is often low, and only a small amount is available to be spent on food. The meals recommended for infants, young children, or their mothers must relate realistically to the money available. Education for such expenditures must be at a suitable level, and the community's rate of illiteracy also must be taken into account.

For economic and other reasons, it does not seem feasible at present for the lower-income groups to feed infants adequately or safely with commercial, usually imported, baby foods. Other means must be found to meet the nutritional needs of this group. One way is to encourage the practice of breast-feeding and to show the mother how to supplement her milk with weaning foods that can be made at home.

Because of these specialized considerations, this manual is organized to encourage the preparation of national or local editions. A simplified edition, adapted and modified for specific localities, can be particularly helpful for auxiliary workers at the family level.

A bibliography of scientific literature and other relevant publications is given as a guide for those who wish more detailed information on the topics considered here.

# Chapter 1

# Growth and Development

## FETAL DEVELOPMENT

"When a child is born it is already nine months old."

It is worth remembering that the fetus develops rapidly from the two cells that joined at conception into an infant with a brain, lungs to breathe with, a heart to circulate the blood, a stomach to digest food, and kidneys to eliminate urine. To support this growth and development, major changes take place in the mother's body.

Under normal conditions, the mother increases, on average, 12.5 kg in weight during pregnancy. Components of this weight increase are shown in Table 1.

TABLE 1. COMPONENTS OF WEIGHT GAIN DURING PREGNANCY[1]

| | | *grams* |
|---|---|---|
| Fetus, placenta, amniotic fluid | | 4,750 |
| Uterus and breasts | | 1,300 |
| Blood | | 1,250 |
| Extracellular water | | 1,200 |
| Fat (by difference) | | 4,000 |
| | Total | 12,500 |

Fat is deposited throughout pregnancy, especially in the period between the 10th and 20th weeks.[1] It acts as a store to draw on in an emergency or during lactation. Several factors related to the function of different organs in the pregnant woman may be responsible for this extra fat deposit. The most important may be increased hunger and, therefore, greater food intake, together with a decrease in physical activity toward the end of pregnancy.

Studies in developing countries among poor mothers show that their weight increase is often limited to only about 5 to 7 kg.[2] Basically, except for fat, the gains shown in Table 1 are the same, although the birth weights usually are somewhat lower than in industrialized countries. As a result, little or no fat may be deposited and other nutrient stores are limited. Studies in widely different countries in Asia and Latin America[2, 3] indicate that, during pregnancy, nutritional intakes are generally low, and the total energy intake is deficient, often by several hundred kilocalories. In addition, it is common knowledge that activity may not decrease, even at the end of pregnancy. Many women continue to till the soil, carry wood and water, and take part in other strenuous jobs until the time for them to be delivered.

## RECOMMENDED INTAKES FOR PREGNANCY

Table 2 shows the amounts recommended[4,5,6,7] for meeting energy and nutrient needs during pregnancy. In the second and third trimesters (four to six months and seven to nine months), requirements for energy, as well as for protein and certain other nutrients, are increased. These extra needs can be met if the mother eats about one-fifth more of her ordinary mixture of foods, provided that she is already consuming an adequate diet (some 2,000 kcal daily). Any dietary advice given to her at this time must be in terms of foods familiar to her, and expressed in quantities of local measures, such as handsful of rice or extra pieces of bread with stew.

TABLE 2. RECOMMENDED DAILY INTAKES FOR PREGNANCY AND LACTATION
(compared with those of woman of 50 kg, a weight typical of many women in developing areas[a])

| | | *Women weighing 50 kg* | *Pregnancy 2nd & 3rd trimester* | *Lactation first six months* |
|---|---|---|---|---|
| Energy | kcal | 2,000 | 2,350[c] | 2,550 |
| Protein[b] | g | 37 | 50 | 60 |
| Vitamin A[d] | µg | 750 | 750 | 1,200 |
| Vitamin D | µg | 2.5 | 10 | 10 |
| Vitamin C | mg | 30 | 50 | 50 |
| Thiamine ($B_1$) | mg | 0.8 | 0.9 | 1.0 |
| Riboflavin ($B_2$) | mg | 1.1 | 1.3 | 1.4 |
| Niacin equivs. | mg | 13.2 | 15.5 | 16.8 |
| Folate | µg | 200 | 400 | 300 |
| Vitamin $B_{12}$ | µg | 2.0 | 3.0 | 2.5 |
| Iron[e] | mg | 19.0 | 19.0 | 19.0 |
| Calcium[f] | mg | 450 | 1,000-1,200 | 1,200 |

Notes:

(a) Activity is moderate.

(b) A safe level of intake of protein should be provided by a national diet that has a score of 70 (see Chapter 5). In this diet, plant proteins predominate, but small amounts of milk, meat, fish, or eggs may be available.

(c) In the first trimester, energy requirement is increased by an average of only 150 kcal/day.

(d) Requirement expressed as retinol.

(e) The amount of iron likely to be absorbed from a diet described in (b).

(f) Calcium intakes should be increased in the third trimester and remain at that level during lactation. (See references, 4, 5, 6, and 7).

## NORMAL BIRTH WEIGHT

Adequate birth weight of an infant is important, because it will determine the ability to adapt to the new environment and develop normally. A large number of factors, some of which will be discussed here, cause variations in weight at birth.

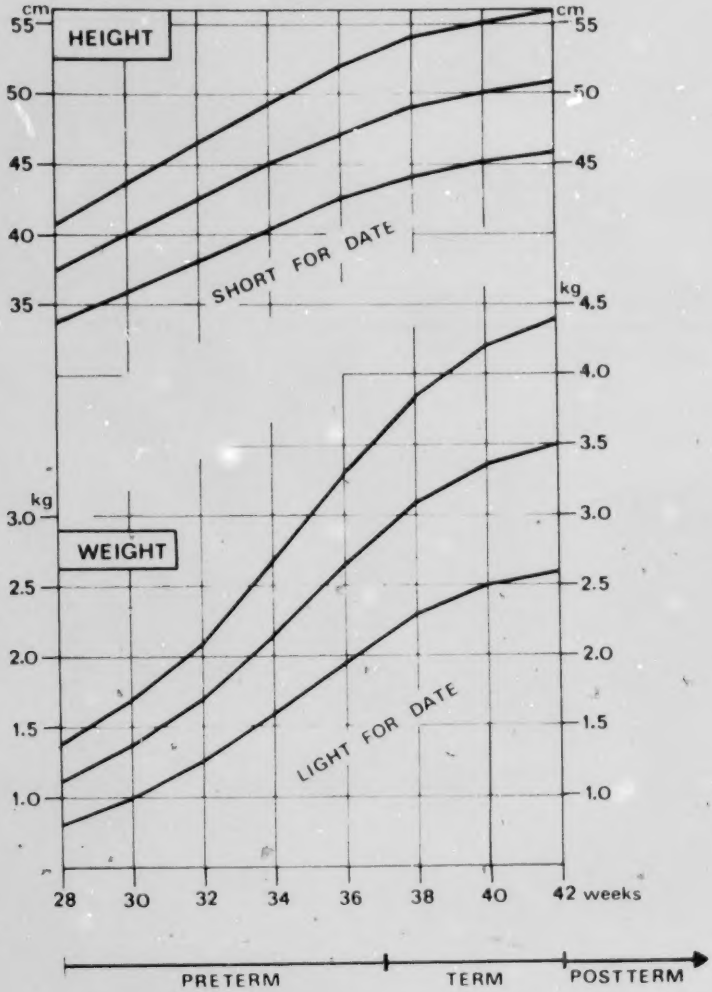



Figure 1. Normal fetal development with good nutritional conditions, showing mean heights and weights — 2 standard deviations. 95% Swedish infants fall between these lines. —Adapted from Engstrom et al.[8]

Under optimal conditions in Europe and North America, normal birth weights for infants of either sex average between 3.3 and 3.5 kg. How this weight develops in fetal life of Swedish embryos is shown in Figure 1. Among other well-to-do ethnic groups, corresponding birth weights usually are reported as slightly lower[2,9] for, even under ideal conditions, these relate to the height of the mother. A tall mother usually delivers a large baby, and vice versa.[1]

Mothers in the same ethnic group, but from a low socioeconomic level, generally deliver babies of lower birth weights, which might average about 2.5 kg. Such differences are shown in Table 3.

TABLE 3. MEAN BIRTH WEIGHTS ACCORDING TO SOCIOECONOMIC STATUS[2]

| | *Mean birth weights in grams* |
|---|---|
| Upper class | 3,247 |
| Upper middle class | 2,945 |
| Lower middle class | 2,797 |
| Lower class | 2,578 |

Clinically, in international classification, the term "low birth weight" is defined as below 2,500 g. Basically, there are two reasons for low birth weight, and these often are closely related: premature, or early, delivery and retarded fetal growth.

## PREMATURE OR EARLY DELIVERY

This may be caused by toxemia, hard work, trauma, acute infection, or multiple births, but in many cases the cause for premature labor is unknown. Maturity of an infant's body function depends on how early it has been delivered. Premature infants are usually thin, have a tendency to low body temperatures, have muscle weakness and thereby have difficulty in suckling, and are more subject to infections of various kinds. Death rates, particularly in poor hygienic environments, are considerably higher than for full-term babies.

## RETARDED FETAL GROWTH

These infants are small for date (SFD), and fetal growth is retarded for reasons relating to the fetus, the placenta, or the mother.

Fetus: infections, such as rubella or syphilis.

Placenta: abnormally small, or with a blockage that causes poor nutrition.

Mother: factors that give rise to poor circulation across the placenta, causing poor nutrition and oxygen supply for the fetus. Such factors include high blood pressure; impaired oxygenation of the blood, such as occurs at high altitudes; diseases of the heart and lungs; acute and chronic infections, such as tuberculosis or urinary-tract infections; malnutrition; anemia; malaria.

Retarded fetal growth may be slight or severe. If severe, a full-term infant might weigh at birth only 1.5 kg, be considerably undernourished, and show recognizable symptoms at birth.

Mothers from the poor sectors of society frequently have only an inadequate diet available and have very limited opportunities for proper antenatal care, which includes the prevention and treatment of malaria, anemia, and infections. This largely explains why lower birth weights are found in these groups. The poor diet may be caused by poverty, but more often it is due to ignorance or to food taboos that may be imposed, especially during the first pregnancy. Under these conditions, an infant may be small, and wrinkled at birth. There may be some immediate difficulties, as with breathing, in adapting to life outside the womb. If fetal stores of glucose are low, there can be a lack of immediate energy during and soon after birth, which, if severe, might lead to convulsions. However, even with a birth weight of about 2,700 g, an infant born in a poor family, of a mother who has had an inadequate diet and malaria, may not show any clinical signs of malnutrition at birth except for being small, or "dwarfed." (Dwarfed means that the infant is both short and light in weight at birth.)

Even under optimal conditions after birth, infants who have been retarded in growth during fetal life might continue to grow slowly for many years. They might also show a tendency toward poorer intellectual performance, compared with infants who grew normally before birth.

To insure the best fetal growth and thereby give the child a good start, it obviously is important to supervise the pregnancy as closely as possible. That includes preventing and treating infectious diseases or high blood pressure, and making the mother—and father!—understand the importance of a good and sufficient diet, so that no taboos restrict the food intake. In addition, the parents should understand the need to slow the mother's work pace, and so allow her to have sufficient rest before delivery.

## POSTNATAL DEVELOPMENT

The normal, well-fed infant who is protected from infections, grows rapidly, particularly during the first few months. This is shown in Figure 2 and Table 4. Weight increases rapidly during the first weeks and slows before the end of the first year. During the first year, weight increases by about 7 kg; during the second year, by 2.5 to 3 kg; and from then on until puberty by about 2 to 2.5 kg per year. At birth, the infant is about 50 cm long. It increases by 25 cm during the first year and less rapidly after that. These figures are for Swedish infants,[8,10] but they should apply to the first few years of young children in any ethnic group, provided they are brought up under conditions that are satisfactory in all respects.

A substantial part of the weight increase during the first few months consists of subcutaneous fat. This can be measured. Arm circumference increases rapidly during the first year and thereafter is fairly constant until the age of five years (see Figure 3). Measuring the arm circumference is a useful screening method for Protein Energy Malnutrition (PEM). At birth, chest circumference is slightly less than head circumference, but it will increase more rapidly and will be greater than

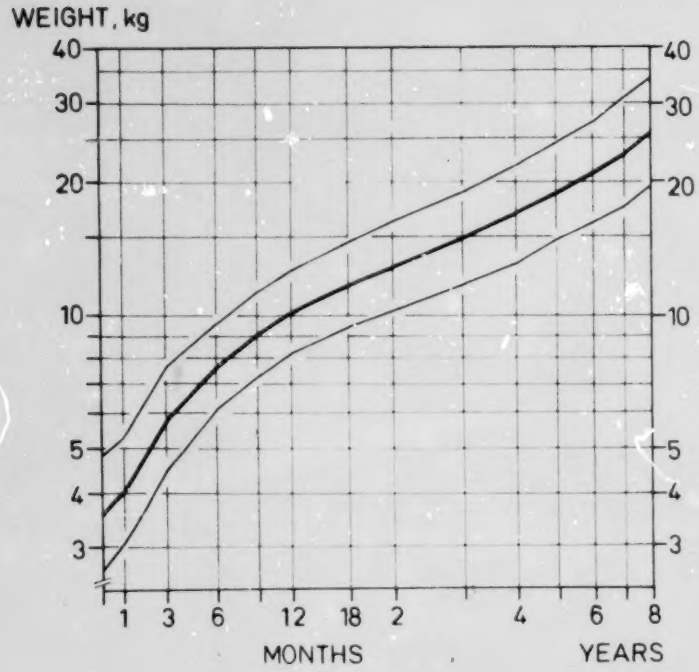



Figure 2. Normal weight development for Swedish boys from 0-8 years, showing mean increase in weight ± 2 standard deviations. (Adapted from Karlberg et al. [10])

TABLE 4. WEIGHT AND LENGTH INCREASES FROM BIRTH
(males)

| *Age months* | *Weight increase/week grams* | *Age years* | *Length cm* | *Increase/year cm* |
|---|---|---|---|---|
| 1-2 | 175 | At birth | 51 | — |
| 3-4 | 150 | 1 | 76 | 25 |
| 5-6 | 125 | 2 | 88 | 12 |
| 7-8 | 100 | 3 | 96 | 11 |
| 9-10 | 75 | | | |
| 11-12 | 50 | | | |

At 5 months: Birth weight x 2
At 12 months: Birth weight x 3

the head after six to 12 months. Under conditions of PEM, subcutaneous fat and muscles on the chest grow poorly, and the head circumference continues to be larger than the chest for a longer time. These measurements, too, are useful screening techniques for PEM.[12]

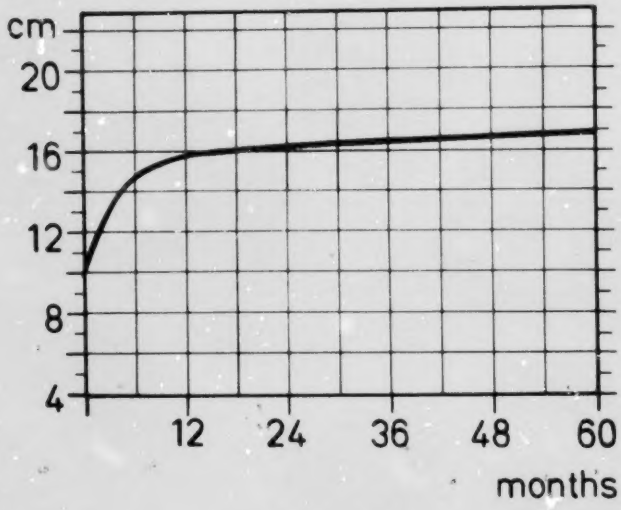



Figure 3. Arm circumference from birth to 5 years. Note that from 12 to 60 months it measures 16 cm. It is not necessary to know the precise age during this period in order to use this measurement.[11]

# Chapter 2

# Lactation

All mammals, from mouse to elephant, breast-feed their offspring. That ability is as important as the ability to mate and reproduce, if the species is to survive. Although sometimes other lactating females may take over if the real mother cannot feed her young, for all practical purposes the offspring's survival is completely dependent on its own mother during its first few weeks or months. The lactation period varies from three weeks or less for the mouse, up to many months for the elephant. During the latter part of the lactation period, the young gradually is weaned to "adult" food.

The milk is well adapted to the special needs of each species. Seal or whale milk, for instance, has an extremely high fat content—42 and 53 percent, respectively—as the young animal must quickly develop an insulating layer of fat so it can endure the cold waters in which it lives. Mother's milk for fast-growing animals normally has a higher protein content than does that for animals which grow more slowly.

The human infant, too, is breast-fed and dependent on its mother's milk for survival. Some 5,000 years ago, the cow began to be used as a domestic animal, probably for its milk. But not until about 50 years ago did the baby-food industry start to manufacture refined, milk-based products as alternatives to breast milk. Before then, if the mother failed to produce milk, the only safe way to feed the baby was to find a wet nurse. This is still true today in most poor areas where hygiene is unsatisfactory.

## PHYSIOLOGY OF BREAST-FEEDING

The breast is made up of about 20 segments, each of which looks rather like a tree with branches and leaves, and ending in the nipple. The branches are milk ducts and the leaves are the alveoli, in which the milk is produced (see Figure 4). The tissues between the ducts and the alveoli consist of fat, connective tissue, and blood vessels. The amount of fat and connective tissue determines the size of the breast.

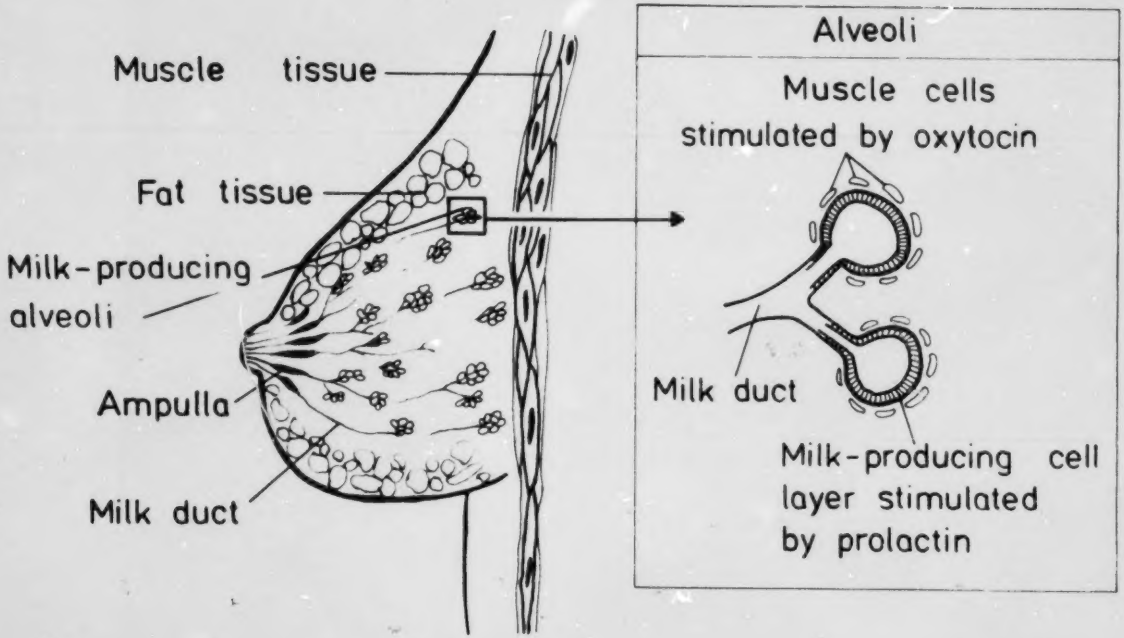



Figure 4. Anatomy of the breast.

During pregnancy, the breast enlarges and the body prepares the ducts and alveoli for lactation. The breast may increase two to three times in weight.[1,13]

After delivery, a hormone (prolactin) produced in the anterior part of the hypophyseal gland at the base of the brain begins to act on the alveolar cells and milk production begins.

The production and ejection of the breast milk is governed by an intricate interplay of nerve reflexes and hormones. When the child is sucking the nipple, a nerve impulse is sent to the mother's brain. From there, impulses are forwarded to the hypophyseal gland (Figure 5) and the production and release of prolactin are stimulated. This hormone reaches the alveolar cells in the breast by way of the blood stream and promotes milk production. Another impulse is sent to the

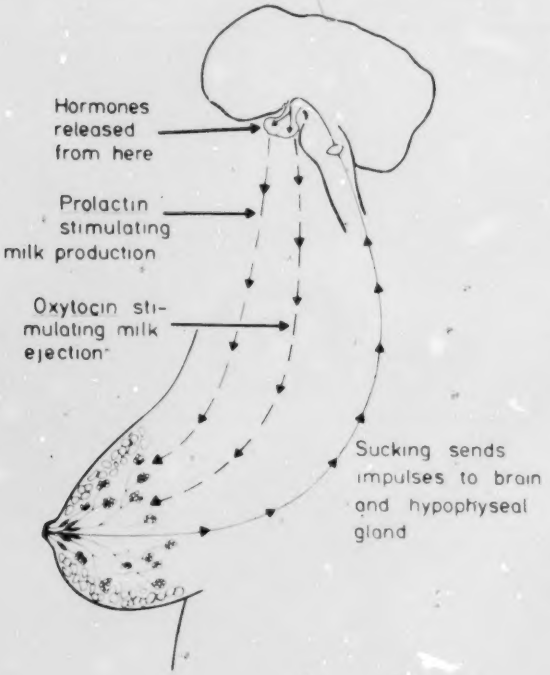

Hormones released from here
Prolactin stimulating milk production
Oxytocin stimulating milk ejection
Sucking sends impulses to brain and hypophyseal gland

Figure 5. Sucking stimulates the production and ejection of breast milk.

Figure 6. A quiet confidence ensures a successful lactation.

Figure 7. Breast feeding helps to establish a close and happy contact between mother and child.

posterior part of the hypophyseal gland, where it stimulates the release of still another hormone, oxytocin, which acts on the muscle cells that surround the alveoli and the milk ducts. When these contract, milk is expelled down the ducts to the nipple, where the child sucks it. This is called the "let-down reflex." The oxytocin also acts on the muscles in the womb. If the child is put to the breast soon after delivery, contraction of the womb muscles may help to stop bleeding.

The let-down reflex may be disturbed easily by pain from cracks on the nipple, tiredness, or stress. The mother may notice that she "dries up," but may not know why. Quiet confidence insures successful lactation and establishes a close and happy contact between mother and child (see Figures 6 and 7).

## AMOUNT OF BREAST MILK

During the last few months of pregnancy, there is a small secretion from the breast. After birth, when the infant starts to suckle, the milk supply increases rapidly. Under normal conditions, about 100 ml is available on the second day,

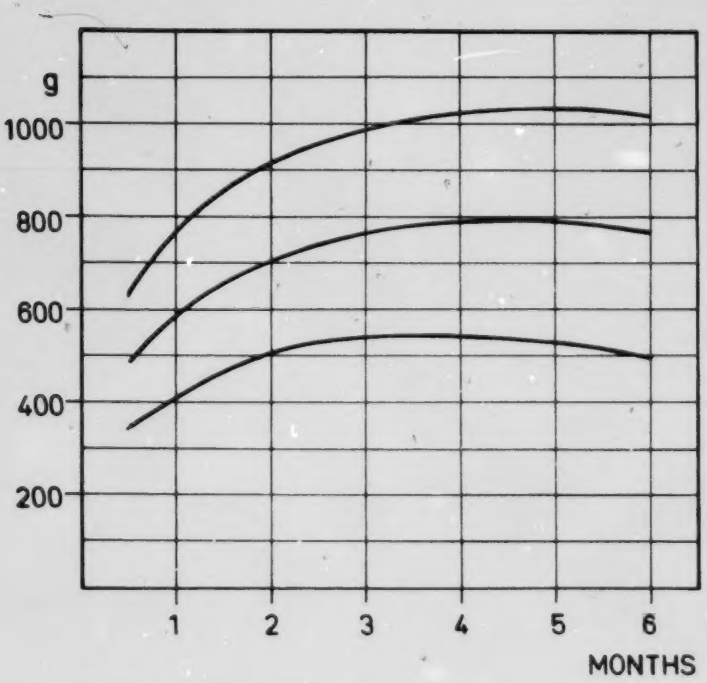



Figure 8a. Breast-milk consumption by infants of well-nourished mothers at different ages.[14]

and increases to about 500 ml by the second week.[13] Effective and sustained milk production is achieved 10 to 14 days after delivery. On average, about 600 ml is consumed at one month and about 800 ml at three months,[4] but there are large variation in the amounts (see Figure 8a).

In European countries, some infants continue to consume 750-825 ml of breast milk for at least six months and, until recently, it was thought that breast-fed infants in developing countries also were receiving breast milk in these amounts.

If the infant is getting enough milk, it grows well. Quite often, however, even in fully breast-fed, healthy infants, weight falters at three to four months. This correlates with an insufficient supply of breast milk—500 ml or less—which cannot provide the energy the child needs in order to grow properly.[17,21] Small amounts, therefore, are not enough on their own, but, by the end of the first year, any breast milk available is an excellent supplement for various weaning foods. On the other hand, some mothers may continue to lactate for a year or two, and often can supply substantial amounts of milk.

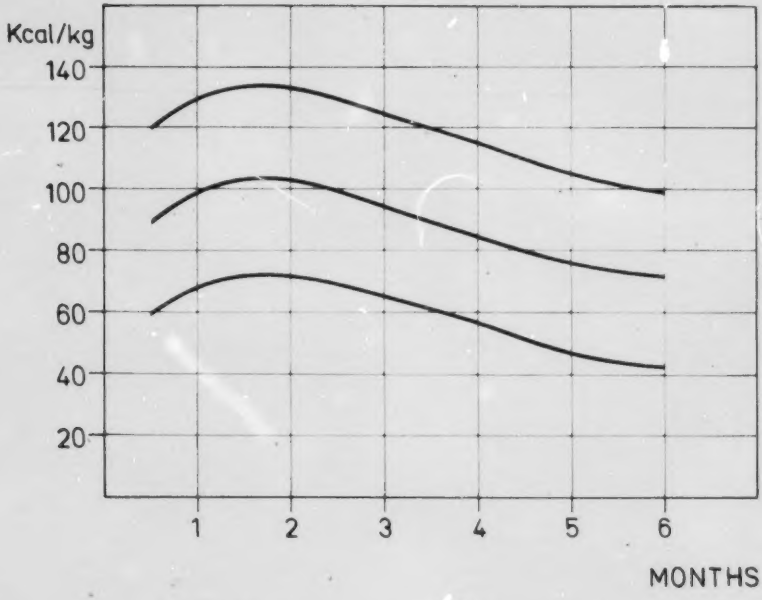



Figure 8b. Breast milk consumption expressed as average energy intake/kg body weight.

## COMPOSITION OF BREAST MILK AND ITS ADVANTAGES FOR THE INFANT

Immediately after delivery, breast milk is yellowish and sticky. This is called colostrum, and is secreted for 10 to 14 days. Thereafter, the mature, white milk is produced. Colostrum differs from mature milk in that it contains less water-soluble vitamins, fat, and lactose; protein, fat-soluble vitamins, and minerals are present in larger amounts. The protein, which is about 1 percent in mature milk may be as high as 10 percent in early colostrum, and transfers to the newborn infant certain factors that protect it from infection, particularly during the first few days.

Protein: It can be seen in Table 5 that unmodified cow's milk has about three times more protein than human milk. Most of the protein is casein; a lesser amount is soluble whey protein. The abundance of casein causes a relatively tough

TABLE 5. AVERAGE VALUES/100 ml WHOLE MILK

| *Constituent* | | *Mature human milk* | *Cow's milk* |
|---|---|---|---|
| Energy* | Kcal | 67 | 66 |
| Total solids | g | 12.4 | 12.7 |
| Protein | g | 1.2 | 3.3 |
| Casein: Whey ratio | | 1:1.5 | 4.7:1 |
| Lactose | g | 7.0 | 4.8 |
| Fat | g | 3.8 | 3.7 |
| Vitamin A (retinol) | μg | 53 | 34 |
| Carotenes | μg | 27 | 38 |
| Vitamin D | μg | 0.01 | 0.06 |
| Vitamin C | mg | 4.30 | 1.80 |
| Thiamine | mg | 0.16 | 0.42 |
| Riboflavin | mg | 0.43 | 1.57 |
| Niacin | mg | 1.72 | 0.85 |
| Pyridoxine | mg | 0.11 | 0.48 |
| Pantothenic acid | mg | 1.96 | 3.50 |
| Folic acid | μg | 0.18 | 0.23 |
| Vitamin $B_{12}$ | μg | 0.18 | 0.56 |
| Iron | mg | 0.15 | 0.10 |
| Calcium | mg | 33 | 125 |
| Phosphorus | mg | 15 | 96 |
| Potassium | mg | 55 | 138 |
| Sodium | mg | 15 | 58 |
| Chlorine | mg | 43 | 103 |

*Calculated from protein, fat, and carbohydrate (lactose), using the factors of 4 calories per gram, proteins and carbohydrates; 9 calories per gram for fat. (Adapted from I.C. Macy, et al., 1953; published in *The Mamary Gland and its Secretion*, S.K. Kon and A.T. Cowie (eds), Volume II, 1961).

curd to form in the stomach. Human milk has less total protein, but a much higher proportion of whey. This forms a softer curd, easier to digest, and more suitable for the infant.

Fat: About half the energy in human breast milk comes from fat that is absorbed much more easily by the infant than is the butterfat of cow's milk. Vitamins A and D are also carried in the fat of milk. The total fat content varies considerably from one women to another, from one phase of lactation to another, and even during feeding. The first milk to flow during suckling, and called "foremilk," has a fat content of only about 2 percent, and looks "thin"; the last fraction, called "hindmilk," contains three times as much fat.

Lactose: This sugar is the only carbohydrate in milk. The content in human milk is higher than in cow's milk and varies little. In addition to providing an easily digestible source of energy, it is converted in the intestine to produce lactic acid. This acid medium helps to prevent the growth of undesirable bacteria and aids absorption of calcium and other minerals.

Minerals: Human milk contains much less calcium than cow's milk but, because it is more easily absorbed, it satisfies the bodily needs of the baby. Both cow's milk and human milk contain only small amounts of iron. Human milk also contains less sodium, potassium, phosphorus, and chlorine than does cow's milk, but this is beneficial for the suckling infant.

Vitamins: If the mother's diet is adequate, all the vitamins, with one exception, that are needed for nutrition and health during the infant's first four to six months are supplied in her milk. Vitamin D content, however, is low, and rickets may occur even in successfully breast-fed infants if their skin is not exposed to sunshine. The amounts of thiamine, vitamin A, and vitamin C have been found to vary according to the mother's diet. The values given in Table 5 presuppose that the mother's diet is a good one; low values have been recorded in several areas of the world where the maternal intake of these vitamins is inadequate.

## ANTI-INFECTIVE PROPERTIES OF BREAST MILK

Antibodies against various microorganisms are transferred from the mother to the fetus via the placenta and help to protect the infant against certain diseases, the most important of which is measles, during the first four to six months.

Antibodies, or immunoglobulins, are also found in large amounts in colostrum and, during the first few days after birth, protect the infant against invasion of bacteria from the birth canal.[12] The immunoglobulins are not absorbed in the intestines in significant amounts, but provide protection against viruses, such as poliomyelitis, or bacteria that may cause infection. For instance, breast milk promotes the growth of certain types of protective bacteria, such as *Lactobacillus bifidus*, which dominates in the infant's intestine during the early weeks. These bacteria produce acids from lactose, making the stools acid and providing a hostile environment for several types of seriously infective bacteria and parasites. Infants fed on cow's milk have neutral or alkaline stools. The level of the immunoglobulins in maternal milk decreases rapidly after birth.

Human milk also has a high content of lysozyme, an enzyme that acts with antibodies against bacteria by breaking down certain of those that might be harmful. Cow's milk has a much lower lysozyme content.[15]

During the first two weeks, human milk contains considerable numbers of white blood cells (1000-4000/$mm^3$), which may carry anti-infective properties from the mother to the infant. They are thought to act by destroying bacteria.

Lactoferrin, a special protein in human milk, has been shown to prevent the growth of certain harmful bacteria by denying them iron.

## LACTATION AND ANTICONCEPTION

Menstruation usually returns to lactating women about 12 weeks after delivery.[12] There are wide variations, however, and at least one-third of the mothers who have nursed their babies continuously for nine months have not resumed menstruation at that time. Ovulation—the release from the ovary of an egg that can then be fertilized—usually recurs a little after the first menstruation, on average about 18 weeks after the birth. Ovulation might, however, start even before the postpartum menstruation.

Thus, although there is less chance of becoming pregnant before menstruation has returned and the mother has been nursing her baby and giving it no supplemental food, lactation should not be relied upon as a safe contraceptive.

## LACTATION AND CANCER OF THE BREAST

Studies in industrialized countries have shown that the rate of cancer of the breast is lower among married than unmarried women, but there is no positive difference in the cancer rate between those who have lactated and those who have not. However, in developing countries, where lactation periods are longer and the birth rates higher, the rate of breast cancer is considerably lower.[16] It would therefore seem that lactation, particularly if prolonged and repeated, may diminish the risk of cancer of the breast. However, factors other than lactation may have a preventive influence.

## DIFFICULTIES IN BREAST FEEDING

In a developing country, and particularly in rural areas, breast-feeding causes little trouble and concern for the new mother. She has learned from her own mother, and watched relatives and neighbors. It is natural for her to put the newborn to the breast immediately after delivery, and to let it suck on demand. Often, she does not know about bottle-feeding as an alternative, although this practice is spreading even in remote rural areas. If the mother should fail to lactate, the infant's grandmother, a relative, or a wet-nurse may take over, but in

some areas a "nonmother" is reluctant to offer her breast as a substitute. The vast majority of women can breast-feed their infants, but a small percentage is unable to do so even temporarily. There are various reasons for this condition, some of which can be traced to the mother, some to the infant.

## Causes Related to the Mother

Inverted nipples: Nipples usually start to protrude at the end of pregnancy and the beginning of lactation, but occasionally they do not, and so make it difficult for the child to suckle. In rare instances, and provided the mother can be taught and supervised properly, the milk can be extracted and fed to the baby by cup and spoon. Alternatively, the child may suck from an artificial teat that is fixed to the breast.

Cracks and fissures: If these appear on the nipple during the first few days, they are very painful and might make it impossible for the infant to suckle. Milk can then be expressed by hand for a day or two while the nipple is allowed to heal.

Breast-milk congestion: This can occur a few days after delivery or at any other time during lactation. The whole breast, or even part of it, might be tender or swollen and infection may develop in the congested segment, and high fever can result. In this case, it is important to continue to empty the breast. This can be done by hand or, if the mother has no fever, by the infant. Gentle massage can be given to the breast and, if available, a cooling bandage applied to it.

Size of breast: If the breasts are very small, they might produce only limited amounts of milk. On the other hand, if the breasts are large and have big nipples, infants, particularly if undersized, might have suckling difficulties.

Chronic or severe illness: The mother may be chronically or acutely ill with tuberculosis (TB), for instance, another type of lung infection, or malaria. If the mother is under treatment for TB, there is no reason she should not breast-feed, although the infant is sometimes given prophylactic medication in addition to a BCG vaccination. Severe illness usually reduces the milk volume considerably, but if the mother's illness is treated promptly and the baby continues to suck, the milk usually returns. Undernourished or starving mothers produce less milk than the well-nourished, and it has been shown that supplementation of a poor diet will increase milk yield.[17,21]

## Causes Related to the Infant

If the infant is born prematurely or has a low weight at birth, it may be too weak to suck properly. An infant ill or with fever suffers in a similar way. A cleft lip or palate also might make suckling difficult or impossible. In these situations, it is even more important that clean, nutritious milk is available to help in the baby's recovery. The only alternative is to express the milk and feed the infant by cup and spoon.

# Chapter 3

# Weaning

The term wean is from an ancient word that means "accustom"; thus it has come to mean the period during which an infant gradually becomes accustomed to foods other than breast milk. This also has been called the "transitional period," and in many developing countries it covers the time between six months and about 2½ years, when the incidence of protein-energy malnutrition and other deficiency diseases is at its height.

The well-being of the infant during weaning depends on: the environment in which the baby lives; the length of the period on breast feeding alone; whether the weaning is abrupt or gradual; the quantity and quality of weaning foods.

## FACTORS INVOLVED IN WEANING

The intimate relationship between mother and infant, which starts in the womb and continues after birth, starts to break up after breast-feeding ceases. Then interactions are weakened between mother and baby, and the effect of the reduced contact might have serious consequences if weaning is too abrupt. In some cultures, for instance, the break occurs when the mother again becomes pregnant and, more particularly, when the young child is separated from her completely and sent away to grandparents.

One of the greatest dangers of the weaning period can be the results of the change over from sterile breast milk and its anti-infective factors to animal milk, semisolid and solid foods, often acquired, stored, and fed in unhygienic and unsanitary fashion. In fact, the weaning process is associated with the highest rate of infection, particularly of the gastrointestinal tract, that the child will encounter in its entire lifetime. Infections, in turn, prepare the way for malnutrition and increase the bad effects of dietary deficiencies.

Weaning starts at various times, and is considered to end when breast-feeding is stopped completely. As we have mentioned, weaning may not begin until well into the second six months of life and may be extended for more than two years. In exceptional cases, it might last up to four years. In the poor urban communities, on the other hand, there is a clear-cut tendency to start weaning when the infant is only a few months old. Sometimes the process may be extended to a year or more, but often breast-feeding stops before six months of

age, and from then on the young child must depend solely on foods other than breast milk. This is critical, and often leads to early marasmus or frank undernutrition.

Among urban families, if the women are in the labor force, they might be entitled to paid maternity leave for a month or two and breast-feeding might be replaced with bottle-feeding by the time the infant is just a few weeks old. Arrangements should be made at a mother's place of work to enable her to breast-feed her baby for a suitable length of time.

Many different patterns lie between these extremes. Numerous reports from industrialized countries indicate a decline and a change in the pattern of breast-feeding. In North America and Europe there has been a steady decline since the 1930s, and today only a small percentage of infants are breast-fed for as long as six months. Previously, breast-feeding was most common in the lower social classes; but today women of the higher social classes and of good education are found to breast feed their babies more often.

Unfortunately, in the developing countries there seems to be the same trend toward shortening the duration of lactation and making more extensive use of "breast-milk replacers." This tendency is spreading from the privileged to the less-privileged classes in developing countries, especially in towns. Jelliffe remarks that "the trend away from breast-feeding toward artificial feeding with cow's milk, usually employing a bottle, is one of the most disastrous exports from the western world in recent times."[18]

Early cessation of breast-feeding is generally related to one or more of the following:

1. Loss of confidence, or feeling that the child does not get sufficient food, even though no signs of underfeeding are apparent. If alternative supplies are available, bottle-feeding is often started, particularly if the child cries at night.
2. Intensive and repetitive advertising that many mothers are unable to resist. Skilled commercials show a smiling, fat, healthy child, presumably the result of having eaten formula X.
3. Economic factors. Because an increasing number of urban women must work, the child is left with a relative. In only a few countries are lactating mothers guaranteed, by law, short pauses in their factory work-time for breast-feeding.
4. Education. All too often, western-trained doctors and other health workers lack interest in the method of feeding. Often, they even promote artificial feeding.
5. Status. The use of tinned milk products as a status symbol.
6. Social factors. The concern that breast-feeding in public is immodest and/or will spoil the mother's figure.

## IMPORTANCE OF BREAST-FEEDING

The advantages of breast-feeding have been widely recognized, particularly for the infant in developing countries. Some of the more important advantages are:

1. Breast milk is clean and readily available. It is convenient, has the right composition at any moment, and is relatively inexpensive.
2. Breast-fed infants tend to contract infections later than do bottle-fed babies. They also have fewer and milder infections and show a lower mortality rate. This has been confirmed in many studies in developing countries, and was true in Europe half-a-century ago.
3. Breast-feeding gives the mother an emotional satisfaction. Because she feels indispensable, a close and happy contact between her and her infant is established.

Many disadvantages and dangers confront an infant, particularly one from a poorer section of society in tropical and subtropical countries, if breast-feeding is ended during the first few months of life. Most importantly, harmful bacteria grow in animal milk if it is not handled in a hygienic way, and powdered milk or fresh cow's milk is expensive, and so might be overdiluted or given in insufficient amounts as an economy measure.

Mothers who deliver at a hospital or a delivery clinic are exposed to the practice of bottle-feeding. "Milk-nurses," who are representatives of milk or baby-food companies, often make regular rounds, distributing feeding bottles and, often, sample tins of breast-milk replacers free of charge. Many poor and uneducated mothers do not realize that once bottle-feeding is introduced and the infant satisfies its hunger, thirst, and energy needs in this way, breast-milk production decreases.

## COST OF REPLACING BREAST MILK

Breast-milk replacers are expensive. If bottle-feeding is practiced, probably the nutritional needs of the infant in a lower-income group will not be met, because replacers take too much of the food budget available for the entire family. More details of costing are given in Chapter 11 and Table 16.

## CUSTOMARY WEANING FOODS

Weaning usually is not difficult in industrialized countries, where it often is interpreted as the changeover from cow's milk formulas to a mixed diet, including cow's milk. Prepared weaning foods are commonly obtained in con-

venient cans or glass containers. An increasing number of mothers in developing countries follow, or try to follow, this type of weaning schedule, an outline of which is shown in Figure 28. This explains how weaning may be arranged in a country with high economic and hygienic standards. This is sophisticated and appears complicated. In developed countries mothers have frequent contact with nurses who work in Maternal and Child Health Centers (MCH), and who give them continuous advice and instructions. In developing countries, a wide variety of foods is used during the weaning process, and breast milk is also given daily. Many foods are prepared according to local custom and tradition, but seldom specifically for the young child.

In most industrialized societies, the infant is scheduled to have about four regular meals a day during the second half-year of life, including one or two milk feeds from either the breast or a formula. In many tropical areas, the baby nibbles, so to speak, and sucks the breast or is given a bottle frequently, maybe 10 to 20 times a day, in response to crying or restlessness. The same is often true with the additional food, for the young child may be given small portions more or less continuously throughout the day. It is difficult for even the mother to estimate the total amount of food intake, but investigations have shown that often the baby is not given enough food, and what there is, is of poor quality. Therefore, it is important to teach mothers that *enough* food of the *right kind* must be given or the infant will become undernourished. Chapter 15 has a number of recipes suitable for use during weaning, based on the staple foods available in various parts of the world.

## WHEN TO WEAN

Provided the infant is growing well, the mother is properly nourished and has an adequate flow of milk, additional food should not be given before the child is four- to six-months old. Up to that time, the breast milk contains all necessary nutrients except vitamin D, which the infant will get if exposed to daily sunshine. At about six months of age, when the first teeth begin to appear, and during the next six months, the baby can more easily manage well-cooked, mashed, and chopped foods.

In the poor sectors of developing countries, weaning should be extended over one to two years, if possible. This will provide the young child with valuable breast-milk protein to supplement other foods.

## HOW TO WEAN

Weaning should always be gradual. It takes time for a young child to become accustomed to the new and different tastes of mashed foods, vegetable mixes, paps, porridges, or other milks. It also takes time to learn how to handle a mouthful of solid or semisolid foods after being accustomed to liquids. In addition—and this is easily forgotten—the baby should be weaned very gradually from constant, close, comforting contact with the mother.

## ON WHAT TO WEAN

Conditions vary from country to country and from rural to urban areas, so it is not possible to formulate a weaning schedule that will suit all conditions and all young children. Therefore, weaning schedules best-suited to each region should be worked out locally by the appropriate health personnel. This requires knowledge about breast-feeding patterns, exisiting weaning practices, and the available foods, either those produced by the family or purchased at the local market. It is a good rule to try to modify existing feeding practices, rather than condemning them. The same applies to those weaning foods that have poor nutritional value; that is, modify them so that they are more nutritious and suitable for the young child.

A simplified weaning process for a mother in a developing country has been devised and is shown as Figure 29, Chapter 14. It was planned on the assumption that the mother is breast-feeding fully for more than six months, and that double and multimixes are introduced only in the second half of the year, starting with small portions of soft fruits and mashed vegetables at about four months. These mixtures will be described in detail in later chapters.

# Chapter 4

# Major Causes of Disease and Death in Children Under 5 Years in Developing Countries

Most developing countries have a high percentage of young people—just under half the population is less than 15 years of age, compared with about one-quarter in industrialized countries—and some 15 to 20 percent of the total population is under the age of five. However, more than 50 percent of the total deaths occur in children under five years of age, in contrast to a figure of less than 20 percent in Europe and North America. The infant mortality rate—that is, the number of deaths that take place during the first year of life per 1,000 live births—varies with the standard of health supervision, the length of breast-feeding, and many other factors. In developing countries, infant mortality usually ranges between 100 or 200 per 1,000, which is nearly 10 times higher than in industrialized countries. The comparison of mortality for the period of one to four years of age is even more unfavorable; it ranges from 30 to 50 times higher than in Europe and North America. Apart from the first few days after birth, the maximum "danger period" is during the second year in many countries.

## PATTERN OF DISEASES

The diseases affecting infants and young children in developing countries are, to a great extent, related to age, environment, and feeding pattern.

In the newborn, illnesses often are connected with premature birth, low birth weight, or a complicated delivery that causes birth injuries or breathing difficulties. Often it is difficult for a prematurely-born infant or an infant with retarded fetal growth to suck the breast, maintain body temperature, mobilize sufficient sugar for energy, and resist infections, particularly in an unhygienic home environment. Such infants may not survive.

The newborn is extremely susceptible to infections from both the mother's birth canal and the environment. As has been pointed out, breast milk contains specific antibodies that protect the infant from these dangers during the first days and weeks of life. Any other food given at this time could be hazardous. Such foods as butter, cow's milk by bottle, and various other mixtures that sometimes are thought of as strengtheners often will cause disease.

In the postneonatal period—that is, after the first month—the baby's health continues to depend on unsupplemented breast-feeding, provided, of course, that the mother can supply enough of it. If supplementary feeding, particularly bottled cow's milk, is started during the first few months, diarrhea will most certainly appear. Other infections and infestations also will be more prevalent. The ordinary cold, with respiratory-tract involvement, is exceedingly common, particularly during the winter or cold rainy seasons. Other serious lung infections include whooping cough, tuberculosis, and those that follow and complicate measles. Measles, which can have serious effects for all children, is particularly dangerous for those in developing countries, mainly because it affects preschool children who probably are malnourished to a greater or lesser degree. This group's death rate from the disease is about 5 to 7 percent.[19] Malaria is another threat. In areas where that disease is endemic, it starts to affect young children at a few months of age, causing fever spells, sometimes accompanied by convulsions and anemia.

From a few months of age, intestinal worms and parasites start to inhabit the intestines of infants, and some may affect their health adversely. For instance, hookworm causes anemia and *Giardia lamblia*, a parasite, causes diarrhea and affects the ability to absorb nutrients from food.

Many different diseases affect the health of infants and young children in developing countries, but the diarrheal diseases and malnutrition are most important from a public health point of view.

## DIARRHEAL DISEASE

Diarrheal disease is the greatest killer of infants and young children. Studies made in India and Guatemala showed that the incidence of diarrhea seems to increase rapidly soon after infants are given food in addition to breast milk; the incidence is particularly high in the second year of life ("weanling diarrhea"). The same studies also revealed that diarrhea is more common in undernourished than in normal children, and that the more severe the undernutrition the more frequent and severe are the diarrheal episodes. The explanation may be that bacteria and viruses that are harmless in the well-nourished individual become harmful in the malnourished, particularly if present in large numbers. This is often the condition if sanitation is poor. On the other hand, it has been shown that the incidence of diarrheal disease in a community decreases sharply when food supplements are given.[19]

In severely malnourished children, damages in the intestinal mucosa impair food digestion and absorption. Malnourished children who suffer repeated episodes of diarrhea may also have become intolerant to lactose, or milk sugar, due to a lack of the enzyme lactase, and so react badly to a milk diet.

It should also be remembered that infections outside the intestines—pneumonia, ear infection, or malaria—may lead to vomiting and loose stools, although usually these symptoms are not as severe as those from true intestinal infections. In only about 20 percent of all diarrheas is it possible to identify a

specific causative agent, such as bacteria, a virus, or a parasite. Attacks of diarrhea can also be caused by an intake of too much indigestible food. Some foods, such as beans, may be poorly prepared and cooked; hot foods, such as chillies, may cause irritation in the intestines, as can some traditional herbal medicines.

## Clinical Picture

Every patient with watery diarrhea has some dehydration and needs replacement fluid.[20] Dehydration may be mild, moderate, or severe. Patients with mild dehydration appear almost normal, even though they might have lost 25-50 ml/kg body weight. The young child with severe dehydration is likely to lose 100 ml/kg body weight or even more. As fluid is lost, signs of dehydration develop rapidly and so should be treated quickly. Unless it is caught while the symptoms are still mild, it will worsen and become more difficult to manage:

*Thirst* is the only early sign of dehydration. Infants show their thirst by crying and being eager to drink any fluid given to them. When dehydration is mild, patients may first appear normal, but, as dehydration increases, they become restless and weak. Finally, they become dazed, then unconscious, their bodies become limp and their hands and feet become cold. This condition is called shock.

If a fold of skin from the belly, shoulder, neck, or upper leg of a normal child is picked up between the thumb and first finger it springs back and flattens out almost immediately. This shows that the skin is elastic. As dehydration develops, the skin flattens out more slowly. If the patient is severely dehydrated, the flattening may take many seconds.

*Loss of body fluids* cause the tissues behind the eyes to shrink, so the eyes appear sunken and dry. In infants, the fontanelle, which is the soft spot on the top of the head, sinks.

*Pulse rate increases* and the strength of each beat weakens. With severe dehydration, the pulse at the wrist may disappear entirely, so the pulse can be taken only at the groin or neck. Such a patient is near death.

*Inability to pass urine* is a common symptom, and resumption of a good urine flow is an excellent sign that normal hydration has returned.

Special danger signs indicate complications that need special treatment: blood in the stool; fever, ascertained by taking the rectal temperature; an enlarged spleen; unconsciousness or convulsions; difficult, fast, or deep breathing; marasmus or kwashiorkor.

## Treatment

The most important treatment for diarrhea[20] is the following:

*Rehydration:* Replace the water and salts lost in the stools. This treatment should be completed within six hours.

*Sustenance:* Continue to replace losses of water and salts so dehydration does not return. Start feeding the usual diet, whether breast milk, cereals, or other weaning foods. Treat other infections or complications. Give drugs if, and only if, needed. This treatment should continue until the diarrhea stops.

Fluid can be given by mouth, nasogastric tube, or by drip, intravenously or into the abdominal cavity. Each health center should try to be able to use any of these methods.

In patients with signs of dehydration, weight is helpful in deciding how much fluid to give. If weighing is not possible, weight must be estimated. A growth chart helps, if the child's age is known.

Most mildly dehydrated patients can be rehydrated through the mouth or nasogastric tube. The mother can be shown how to give about one teaspoonful of fluid to the child every minute, and breast-feeding should be continued. Giving fluid by nasogastric tube is possible only if attendants are available, and should be administered when the patient cannot drink enough fluid to keep up with the amount required for rehydration or when there is severe vomiting. The most suitable fluid for oral and nasogastric use is a glucose-salt solution made in one liter of water:

| | grams |
|---|---|
| Sodium chloride (table salt) | 3.5 |
| Sodium bicarbonate (baking soda) | 2.5 |
| Potassium chloride | 1.5 |
| Glucose (dextrose) | 20.0 |

Glucose is a vital ingredient, and helps the salt and water to be absorbed into the body.

If this solution is not available, a salt-and-water solution can be made at home by using a "thumb-and-two fingers pinch" of table salt in each pint, or half liter, of water, juice, or tea. This mixture is not the best, and should be used only if no other solution is available.

Like nasogastric feeding, intravenous rehydration is necessary if the patient cannot be given enough fluid by mouth to keep up with the fluid losses caused by severe diarrhea or vomiting. Every patient with severe dehydration, and those who do not do well with oral rehydration, need intravenous fluids. They must be treated in a clinic or hospital, because the right amount of fluid must be kept flowing into the vein.

Intra-abdominal rehydration is used in some clinics, but is effective only in children who are not in shock. It is best given in a single, large dose of fluid, 70 ml/kg, before the patient is sent home or to the hospital. Glucose-salt solutions by mouth or nasogastric tube can be just as effective, in many instances. Fluids used for intraperitoneal drips are the same as those for intravenous rehydration, and sterile techniques are very important.

Starvation is especially harmful during an illness such as diarrhea. Breast-feeding should continue if the child is on breast milk, but other food should not be given until the child is able to eat. This period, however, should be as short as

possible and not last more than six to 24 hours. Many young children with diarrhea are already poorly nourished, and loose stools may in some cases be, in part, the result of malnutrition. If the infant is not able to suckle, it is advisable to discontinue breast-feeding for a short period—a day or so—during which time the mother's milk should be expressed; the infant should be returned to the breast as soon as possible. In partly breast-fed infants, the supplementary foods, cow's milk or a gruel, should be stopped temporarily and replaced by rehydration fluids.

After a short period of intestinal rest, small, frequent feedings should be started. These may consist of diluted boiled milk, preferably skimmed, or soured milk, prepared either locally or commercially. The feedings should be increased in amounts and strength over the next day or two, and followed by such foods as gruel, porridge, or mashed bananas. In the most uncomplicated cases, the child should be back on a normal diet in three to four days.

Some children may have successive diarrhea attacks when fed cow's milk especially in dried, skimmed-powder form. For such children, cow's milk should be avoided if other foods are available as sources of energy and protein but, if it must be given, quantities should be limited to about 150 ml, diluted with clean boiled water or glucose-salt solution, given every four hours.

It is important to follow up on undernourished children who have recovered from an acute attack of diarrhea. As long as they remain malnourished they are at risk for more of the disorder, as well as from infection, further malnutrition, and death.

Drugs are not usually needed in mild or moderate cases of diarrhea, but one of the less-absorbable sulfa drugs, such as sulfaguanidine, may be used. In severe cases of dehydration, administration of fluid is much more important than drug therapy. The decision to use drugs should be left to the doctor or the medical assistant.

## DEFICIENCIES IN ENERGY, PROTEIN, AND OTHER NUTRIENTS

Certain vitamin—and mineral—deficiency diseases occur with varying frequency in infants and small children. These include avitaminosis A, rickets, and iron-deficiency anemia. The incidence varies greatly from place to place, depending upon both the local dietary pattern and cultural factors. In some countries, eye damage resulting from vitamin-A deficiency is reported to occur frequently. If this is a problem, an injection of vitamin A should be given to the child to help prevent blindness. The vitamin-A deficiency disease xerophthalmia, which may lead to blindness, may be prevalent despite the presence in the area of vitamin A-containing foods, which may not be eaten in the normal daily meals because the inhabitants of the region do not know their value.

Protein-energy malnutrition (PEM) is the most common form, and is seen during the transitional period of weaning. It is the world's principal public health problem and, if unchecked, will leave many children permanently handicapped both physically and mentally.

## Clinical Picture

The nutritional status of young children may be viewed as a slope running downward from normal, to mild, to moderate protein-energy malnutrition, with severe syndromes, such as kwashiorkor and nutritional marasmus, at the bottom. What happens when too much or too little of the right kind of food is eaten is shown diagramatically in Figure 9.

In developing countries, the majority of young children pass through a mild, moderate, or severe form of PEM during the weaning, or transitional, period. This is illustrated in Figures 10 to 15. The weight increase, which may represent the general development, is illustrated in Figure 10. During the first few months, the infant develops well, provided there is a good flow of breast milk. From four to six months of age, or even earlier, growth falters and the weight curve flattens. This is due to the combined effect of inadequate diet and infection. Some infants develop a more severe type of malnutrition, which may be a nutritional marasmus, kwashiorkor, or some intermediate form. The small proportion of infants who get sufficient energy and nutrients in their food have few infections and develop well.

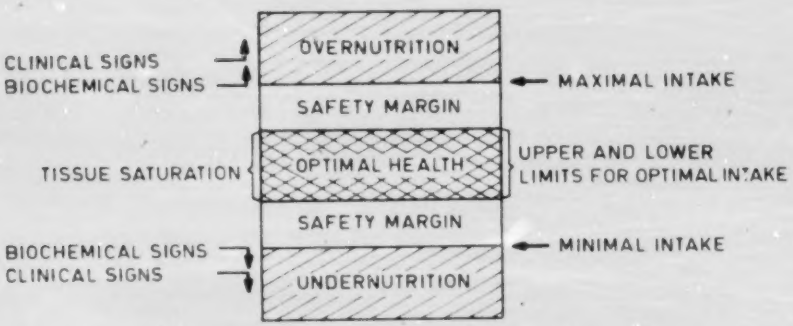



Figure 9. The steps from overnutrition to undernutrition. (Courtesy Prof. B. Lindquist, Lund, Sweden).

Typical marasmus is seen in the infant in Figure 11. The sufferer is usually less than one year, but may be older, has severely retarded growth, and a low weight for age, usually below 60 percent of the standard weight. The muscles are markedly wasted. They are "flabby," which is often best felt on the thighs and buttocks, where the muscles should be thick and strong. Because the subcutaneous fat is poor or almost absent, the skin is loose and seems to be too big

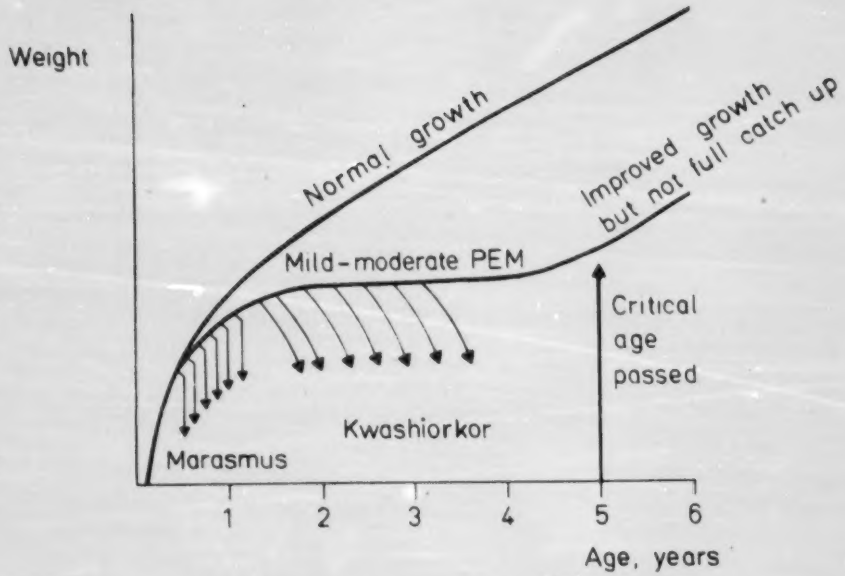



Figure 10. Effect of protein-energy malnutrition (PEM) on growth.

Figure 11. One-year-old child with typical nutritional marasmus.

Figure 12. A child with typical kwashiorkor.

Figure 13. A child with moderate PEM. Note the wasting of muscles, which is expressed by muscular weakness.

Figure 14. A child with less than 70% weight for age.

Figure 15. Same child having recovered, now with more than 90% weight for age.

for the body. Nearly always, such an infant has an "old man's face" or a "monkey face." A marasmic patient does not have hair-color changes and there is no edema.

In addition, there may be associated signs of various vitamin deficiencies, depending on the local dietary pattern.

A child with typical kwashiorkor is shown in Figure 12. This disease usually occurs in children one to three years of age. Growth is retarded and muscles are wasted and flabby, but the subcutaneous fat usually is not as poor as in marasmic children. Some "sugar babies" may even be fat, indicating a sufficient or more-than-sufficient energy intake. Children with kwashiorkor always have edema, mainly on the feet and lower legs, and they are miserable and apathetic. Because they are not hungry, they are difficult to feed. Often the hair changes color, sometimes even to gray; it becomes sparse, straight, and can be pulled out easily. The children appear "moon-faced," their skin is pale, and often they are anemic. In severe cases, a "flaky-paint" rash may be seen, particularly around the large joints.

Intermediate cases of PEM are not uncommon, and children suffering from marasmic kwashiorkor are often seen.

As has been mentioned, children who are improperly fed during the weaning period have a mild or moderate form of malnutrition. This is indicated by low weight-for-age and by other subnormal body measurements, such as height, arm circumference, and head-to-chest ratio. An examination may also reveal wasted muscles, hair-color changes resembling those seen in kwashiorkor, and apathy (see Figure 13). Such children may be precipitated into a more severe malnutrition, such as kwashiorkor, by an attack of measles, a diarrheal disease, or pneumonia.

Prevention is better than cure, but treatment of undernutrition, as shown in Figure 14, should result in recovery, as shown in Figure 15.

## SCREENING FOR MALNUTRITION

Prevention of disease is, of course, one of the most important tasks in world health. The prevailing deficiency diseases and infections, so common in infants and children in developing countries, undoubtedly are preventable to a great extent, largely by existing means.

An important task of the staff, particularly at MCH centers and at "under-5 clinics," is to trace those children who are in danger of becoming malnourished, so that the development of serious deficiency disease can be prevented. Such clinics, however, usually serve a large number of patients, and it may be difficult to screen out for special care those children who run the greatest risks of developing serious illnesses.

## Weight Charts

When a child is under five years of age, weight is the best method of assessing the state of nutrition. It requires considerable skill and experience, however, to decide from a single examination or weight measurement—or even a series of weight measurements—if a child is growing satisfactorily.

The best and simplest way is to plot the weight on a specially designed weight chart, shown in Figure 16. At each visit to the MCH center or the under-5 clinic, the weight is plotted on a chart. With some training, auxiliary staff can do this easily.

Charts such as these have been tested by WHO in many countries and have been proved to be of great value. They can also be worked out locally. Because weight is related to age, difficulties may arise in those areas where mothers are uncertain of their children's age, but information can be obtained with reasonable accuracy, at least for infants and small children, by relating the date of birth to local events. The construction of a calendar of local events that will be known by the majority of the community is useful for other purposes, as well.

Flattening of the child's weight curve is the earliest sign of PEM, and may precede clinical signs by weeks or even months. In some places, the mother keeps the chart and the clinic tells her the significance of the lines on the chart. The upper line usually represents the median of the local or international standard weights, and the lower line indicates 80 percent of that standard. In other places, the weight chart is kept at the clinic and in still others the mother keeps a duplicate copy of the clinic's chart. The decision on which of these arrangements is best depends on local conditions and the degree of cooperation by the mothers.

## High-risk Factors

Various studies have identified certain high-risk factors that have an influence on the child's nutritional state. These are related to medical, social, economic, and educational conditions. They include:

Low birth weight.

Twins or multiple births.

High birth order.

Death of siblings, particularly if before 12 months of age. Measles, whooping cough, and severe or repeated diarrheal episodes in the early months of life.

Death of either parent, a broken marriage, or an unmarried mother.

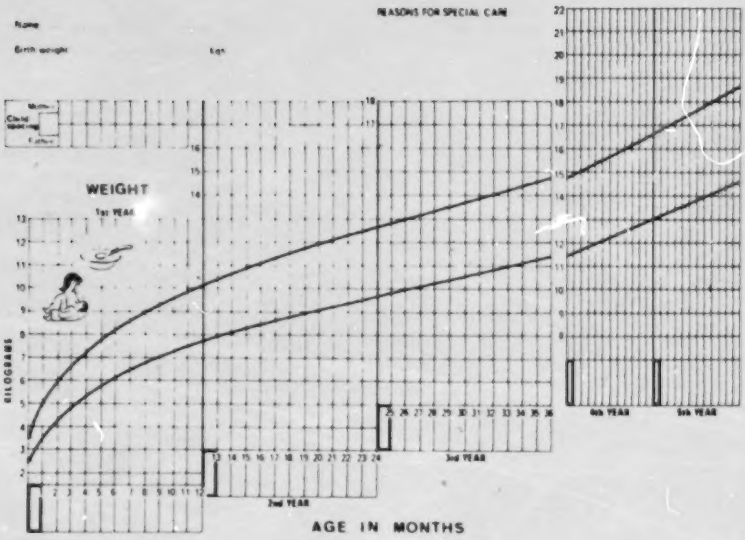



Figure 16. A model weight chart for use in MCH and Under 5's clinics in developing countries. (WHO, Geneva).

Illiteracy of mothers, in areas where there is a fair degree of literacy, and low intelligence.

General poverty.

Recent migration of the mother to the area.

Other local factors.

A high-risk list can be worked out for each area. It should be based on factors that have been found to relate to protein-energy malnutrition in the area. A child with one or more of these risk factors should be marked by a red star, probably on a weight chart, or on a special list. A "red-star book" might be kept on these children, or their red-starred charts could be kept separate. In any case, the red-starred children should be given special attention. They should be weighed more frequently, and more home visits should be made to detect faltering growth and other signs of malnutrition in their earliest stages. If possible, they should be examined weekly by a doctor or the most experienced health worker.

# Chapter 5

# The Nutritional Value of Food and Its Use During the First Five Years

Because they are growing fast, the energy and protein needs of infants and young children are considerable. Whereas a man needs about 50 kilocalories and a little more than 0.5 gram protein for each kilogram of body weight, an infant requires more than twice as much energy food and three times as much protein. However, although the infant needs more energy and protein for each kilogram of his weight, it is obvious that the total amount of food eaten will be a great deal less than that eaten by the parents.

## ENERGY

Kilocalorie is a familiar term that has long been used to describe both the energy requirement of an individual and the energy value of food. Because this same term is used for both intake and output energy, one value may be equated easily with the other. In any individual, even at rest, normal body functions have a basic need for energy. Allowances must also be made for body size and composition, to a small extent for the effect of climate, but most of all for physical activity.

In the International Systems of Units (S.I.), the unit of energy is the joule (J). However, this value is too small to describe the energy value of a diet; hence, the kilojoule (kJ) and the megajoule (MJ) are of more practical use:

$$1 \text{ kcal} = 4.184 \text{ kJ} \qquad 1 \text{ kJ} = 0.239 \text{ kcal}$$

$$1000 \text{ kcal} = \begin{cases} 4184 \text{ kJ} \\ 4.184 \text{ MJ} \end{cases} \qquad \left.\begin{matrix} 1000 \text{ kJ} \\ 1 \text{ MJ} \end{matrix}\right\} = 239 \text{ kcal}$$

The energy value of a meal might be described in kilojoules, but for total daily intake or expenditure, megajoules are more suitable.

## ENERGY REQUIREMENTS

A Joint FAO/WHO Expert Group has made recommendations for energy requirements for infants and children of different ages, independent of the country in which they live.[4] These requirements are averages, and are intended

to be used for planning the food requirements or meals for groups of children. In any group, some will need more and some less, and children's energy needs depend to a great extent on their opportunities to be physically active. Active children need more food energy than other children of the same age who still are being carried on their mother's backs. Requirements for energy and other nutrients are shown in Table 6, which can be used as a guide when estimating the needs of an individual child.

TABLE 6. RECOMMENDED DAILY INTAKES FOR INFANTS AND YOUNG CHILDREN[a]

| Age | | *months* <3 | 3-5 | 6-8 | 9-11 | *years* 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|---|---|---|---|
| Weight[b] | kg | 4.6 | 6.7 | 8.3 | 9.6 | 11.4 | 13.6 | 15.6 | 17.4 |
| Energy: | | | | | | | | | |
| kcal/kg | | 120 | 115 | 110 | 105 | | | | |
| kcal/day | | | | 915 | 1000 | 1180 | 1360 | 1560 | 1720 |
| Protein: | | | | | | | | | |
| g/kg[c] | | 2.4 | 1.85 | | | | | | |
| g/day[d] | | | | 20 | 20 | 21 | 23 | 27 | 30 |
| Vitamin A | μg | (e) | (e) | 300 | 300 | 250 | 250 | 250 | 300 |
| Vit. D[f] | μg | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| Vitamin C | mg | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 |
| Thiamine | mg | (e) | (e) | 0.36 | 0.4 | 0.47 | 0.54 | 0.62 | 0.69 |
| Riboflavin | mg | (e) | (e) | 0.50 | 0.6 | 0.65 | 0.75 | 0.86 | 0.95 |
| Niacin equiv. | mg | (e) | (e) | 6.0 | 6.6 | 7.8 | 9.0 | 10.2 | 11.4 |
| Folate | μg | 40 | 40 | 60 | 60 | 100 | 100 | 100 | 100 |
| Vit. $B_{12}$ | μg | 0.3 | 0.3 | 0.3 | 0.3 | 0.9 | 0.9 | 0.9 | 1.5 |
| Iron[d] | mg | (e) | 7 | 7 | 7 | 7 | 7 | 7 | 7 |
| Calcium | mg | (5) | (5) | 550 | 550 | 450 | 450 | 450 | 450 |

Notes:

(a) See also the notes in Table 2.

(b) There is little difference between the requirements for boys and girls at these ages (0-4 years). These figures refer to male requirements; the weights represent the 50th percentile for males.

(c) This protein is equivalent to breast-milk protein.

(d) Amount allows for the total diet with a score of 70.

(e) Breast-feeding is assumed to be adequate, if mother is well-nourished.

(f) Adequate exposure to sunlight may partially or totally replace dietary vitamin D (10 μg = 400 I.U.). (See references 4, 5, 6, 7)

Foods contain a supply of proteins, fats, and the carbohydrates—sugars and starches. The energy value of these constituents of the diet is as follows:

| | | |
|---|---|---|
| Proteins | 4 kcal / gram | (or 17 kJ) |
| Fats | 9 kcal / gram | (or 37 kJ) |
| Carbohydrates | 4 kcal / gram | (or 17 kJ) |

## PROTEIN IN FOODS

A child must have enough food, and it must be of the right kind. The quality of food depends on the nutrients it contains, and the most important of these is protein. Protein can be a source of energy, like fat and carbohydrate, but this is not its main use. It is essential for the structure and function of all the cells in the body. Protein is part of all tissues, including muscles, bones, teeth, skin, and nails. Body fluids, such as blood, contain protein, as do many substances necessary for regulating chemical process in the cells.

During digestion, food proteins are broken down into their constituent amino acids, which contain nitrogen. After being absorbed, they are carried by the blood to take part in the constant renewal of tissue, a process that continues throughout life. Amino acids also are involved in the building of new tissue, particularly during the rapid growth period in infancy and early childhood, during pregnancy and lactation, and after infections or injuries. All of these processes use protein for specific purposes, which require specific mixtures of amino acids and energy. To build one gram of body protein, the cost is six kcal of energy.

All animal and plant foods contain about 22 amino acids in varying proportions. Given enough nitrogen-containing material and energy, the body can manufacture 14 of these for itself. However, it cannot make the remaining eight, and these must be supplied in the food. The essential amino acids are:

| | |
|---|---|
| Isoleucine | Phenylalanine |
| Leucine | Threonine |
| Lysine | Tryptophan |
| Methionine | Valine |

In addition, histidine is considered essential for infants and for premature babies.

Although there is a great deal of information about the body's total requirement for nitrogen or protein, less is known about its exact need for each of the essential amino acids. There is, however, an ideal pattern of these amino acids that is thought to be the most suitable for humans and can be used for body-building purposes. In some foods, such as eggs and milk, the proteins have a pattern that is similar to this ideal, and such foods are the most valuable in human nutrition, especially for children.

In other foods, one essential amino acid may be present in only very small quantities, and this limits the use the body can make of the others to build tissues. The quality of a protein is closely related to its pattern of amino acids. The ideal pattern for human requirements can be used as a reference, or standard, with which other food-protein patterns can be compared. A food protein with a pattern that is similar to this reference is said to have a high score and will be of good value. A low score indicates poor quality and a pattern very different from the reference. Patterns formed by mixtures of foods, such as are eaten in ordinary meals, also can be compared with the reference pattern, because the amino acids in the proteins of one food can supplement those in another. This relationship is important.

Cereal proteins, although they contian ample amounts of methionine and cystine, the sulphur-containing amino acids, they have little lysine, whereas legumes contain lysine in fairly large quantities. Where cereals and legumes are eaten together, as is common in many parts of the world, their amino acids supplement one another. The result is that the score of the meal is better, because the pattern of amino acids in the combined mixture is closer to the reference pattern than is either food alone. (How these scores can be calculated simply is given in Appendix A.)

Most meals are mixtures of foods, and it is important to know their protein value to make certain that it is good enough for feeding infants and young children. The quantity of protein in each food can be calculated from food-composition tables, but the quality of the protein is equally important. Only when these factors are taken together is there an indication of how much of the proteins eaten will actually be used for building body tissues.

## PROTEIN REQUIREMENTS

Because foods differ in the quantity and quality of proteins they contain, requirements have been expressed in terms of reference protein at a level considered to be safe for maintaining health. The protein is similar to that in human milk and in eggs, and because it has an ideal pattern, with a score of 100, it will be completely used for tissue building, provided enough energy is available at the same time.[4,22]

The advantage of the term *reference protein* is that the recommendations are independent of any dietary pattern and can be applied in any country. But for practical use, reference protein must be converted into the equivalent amount of the proteins provided by the foods that are available locally in order to give a safe level of intake. In a country where the average diet is based on wheat and there are adequate amounts of foods from animal sources, the protein value will be high and the score might be about 80. The reference requirements are converted, as is shown, into grams of those foods that are used traditionally.

For safe level of intake at one year of age:

Requirement for reference protein (score 100): 14.5g

Requirement for protein from local foods (score 80): $\frac{100}{80} \times 14.5g = 18g$

In a country that also uses a cereal, but depends mainly on plant sources, such as legumes, for its proteins, the average score of diet might be 70, so the requirement for proteins from the local foods is higher (see Table 6).

Requirement for protein from local foods (score 70): $\frac{100}{70} \times 14.5g = 21g$

Where the diet is based on a starchy staple, such as plantain or cassava, with little protein from animal sources, the requirement in terms of food proteins is still higher, as the average score of the diet might perhaps be 60.

Requirement for protein from local foods (score 60): $\frac{100}{60} \times 14.5g = 24g$

However, unless the total amount of food eaten covers the needs for total everyday activity, the protein will not be used specifically for tissue-building; some will be used as an additional source of energy.

Because of this restriction, the requirements for protein always should be considered together with those for energy. One way of doing this is to express protein requirements in terms of the energy they represent as a percentage of total energy needs. This can be illustrated by using the FAO/WHO recommended intakes for an infant in the following way:

Protein (reference) requirement per day: 11 g = 44 kcal (11 x 4)

Energy requirement 550 kcal

$$\frac{\text{Protein requirement as kcal}}{\text{Energy requirement kcal}} \times 100 = \frac{44}{550} \times 100$$

or

Net dietary protein energy % 8%

This is a net value, because, by definition, all the protein should be used efficiently for one of its specific purposes. In other words, the net dietary protein energy percentage (NDpE%) indicates that at least 8 percent of the day's total energy should come from proteins provided in these amounts or its equivalent foods.

Requirements, or a safe level of intake, vary according to age, and an infant's net dietary protein energy should not be below 8 percent, which is the approximate value of breast milk. As the infant grows, energy requirements increase and the percentage from protein decreases until, at one year, the NDpE percentage is about 5, always supposing that enough food is eaten and its protein score is 100. If the score is not 100, the requirement in terms of that particular food protein is different. The percentage of a protein contribution to total energy is higher in such a diet adequate in other respects.

Foods also can be scored for their protein *quality*, so the quantity available for complete use, or the net amount, can be calculated. This net amount or

adjusted quantity can be expressed in the same terms (NDpE%), so that food protein values can be related to requirements of reference protein.

The protein value of some staple foods can be seen in Table 7. Some cereals approximate the safe requirement for protein toward the end of the first year of life. However, other factors also must be taken into account. An important one is the *total quantity, or bulk*, of the staple needed to supply the protein required.

TABLE 7. PROTEIN VALUES OF SOME STAPLE FOODS COMPARED WITH BREAST MILK

| *Breast milk* | *NDpE% 8 (approx.)* | | *NDpE%* |
|---|---|---|---|
| Maize | 4.5 | Cassava | <1 |
| Millet/sorghum | 4.9 | Banana/platain | 1.5 |
| Rice | 4.9 | Sweet potato | 3.4 |
| Wheat | 6.0 | Yam | 4.8 |
| Oats | 7.0 | Potato | 6.0 |

## FACTORS AFFECTING THE PROTEIN VALUE OF FOODS

A major cause of malnutrition is, of course, underfeeding, which can occur even if the diet is balanced. When food supplies are short, the body uses some proteins for energy, and as a result the amount available for growth or tissue-building is less.

The quantity of total daily food eaten is the most important factor affecting the proper utilization of the protein in a meal, particularly for an infant. The amount and quality of protein also is important, as are amounts of vitamins, minerals, and, to a lesser extent, the essential fatty acids.[23,24]

Fevers, infections, and parasites in the child also can affect the protein value. The relationship between nutrition and infection is complex. The effect of malaria, for example, can be a reduction of protein value by about half, because energy needs have increased.[25 a,b] Hence, it is important to calculate the energy and protein value of the available local foods eaten at meals, and to equate the result with the requirements of infants and young children. The additional needs of illnesses must be taken into account when planning meals for young children. Preparing suitable mixtures of foods is essential because only a few of the staple foods have protein values that approach that of breast milk (see Table 7), and this must be supplemented from the age of about six months to supply increased needs for energy.

All the suggested food mixes and recipes given in this manual have been designed to suit infants and young children. If enough is eaten each day, the foods will supply both energy and protein needs and most other nutrients, as well. The recipes use foods with which most housewives are already familiar. They can be prepared and cooked at home, in utensils she already owns.

## OTHER NUTRIENTS

Lack of variety in the diet, in addition to dulling the appetite, is sometimes responsible for other deficiencies associated with protein-energy malnutrition. By themselves, tubers, starchy roots, or cereals cannot provide all the nutrients essential for satisfactory growth and development, even if enough could be eaten for total energy needs. Other foods, many from animal sources or legumes, have both good-quality protein and other nutrients important in a balanced dietary intake. In planning children's diets, it is most unwise to focus attention only on energy and proteins, for there must be a regular and adequate intake of all nutrients available from a wide variety of foods, particularly when supplies of breast milk have ceased.[26]

We have mentioned that, in many countries, the major cause of blindness in children is a lack of vitamin A. This could be prevented if children's meals offered a greater choice of foods and more vegetables, especially dark-green leafy ones, and fruits.

### Vitamin A

Preformed vitamin A is fat soluble, is present only in foods of animal origin, and often is associated with protein. It is in meat, particularly liver, in eggs, in the flesh of fatty fish, the livers of all sea fish, in milk fat and cream. The vitamin also can be formed in the body from certain carotene pigments, the most important of which are the $\beta$-carotenes. These are primarily in plant foods, such as dark-green leaves or yellow and red vegetables, most yellow-fleshed fruits, and red palm oil. In many cases, carotenes are the principal sources of vitamin A in the diets of young children. Except for those in whole milk, carotenes are not utilized efficiently, and after digestion and absorption, only one-sixth of the amount in the food finally functions as vitamin in the body.

In hot, dry climates, where fresh, leafy vegetables and fruits are not always available, vitamin-A deficiency is common. It also is prevalent in moist, tropical areas, such as Southeast Asia, where edible green leaves are abundant, but little used. A high incidence of blindness is known to occur in some areas where red palm oil is grown for export but not used for human food. This is particularly tragic, because it could be avoided. Blindness adds further to public-health problems in areas where finances for rehabilitation are limited and medical services already are strained.

Only a small proportion of the body's vitamin A is concerned with normal eye function and its ability to adapt to the dark. Vitamin A has other functions, such as maintenance of normal, healthy, epithelial tissues and normal development of the skeleton. During pregnancy, an adequate intake of the vitamin is needed to provide satsifactory liver stores and allow for the infant's normal growth during the first few months of life.

Both the preformed vitamin and the carotenes are fairly stable under normal cooking conditions, though some loss occurs at temperatures of 100°C or more.

Losses increase in strong sunlight or higher temperatures as, for example, those produced during the process of shallow frying, or the refining of red palm oil.

Pure vitamin A is now available in its crystalline form, retinol, and can be measured in units of weight, micrograms. This compound is used as the reference standard, and replaces the need to use international units for expressing requirements or for measuring intakes from food. Because several substances, such as the carotenes, have vitamin-A activity, we recommend that their retinol equivalent be used when estimating dietary intakes. One international unit (I.U.) is equivalent to 0.3 μg retinol or preformed vitamin A, or 0.6 ug β-carotene activity. In plant foods the utilization efficiency of β-carotene is only 0.167.

To calculate the retinol equivalent value of the diet, the following equations may be used if the I.U. of vitamin A and β-carotene are reported separately.

*For animal foods*

I.U. of vitamin A x 0.3 = μg retinol

*For plant foods*

(I.U. β-carotene x 0.6) x 0.167 = I.U. β-carotene x 0.1 = μg retinol equivalent

*For milk and milk products*

(I.U. vitamin A x 0.3) + (I.U. β-carotene x 0.33) = μg retinol equivalent

(Calculations are made on the basis of utilization efficiency of carotenes in milk which is 0.33.)[27]

By using these conventions, the total vitamin-A activity in the diet can be calculated and equated to the recommended intake, which is expressed as retinol micrograms.[5]

## Vitamin D

Vitamin D also is fat soluble, and is unique because it is available both from food, although the sources are limited, and through the action of the sun's ultraviolet rays. Once in the body, the vitamin is associated with calcium in bone, the teeth, and blood. It influences the absorption of dietary calcium and the amount excreted through the kidneys. It also has some control over the exchange of calcium between bone tissue and body fluids. Vitamin-D shortage can seriously affect normal bone growth. In tropical countries, the sun can provide enough vitamin D. However, in some cultures, women and children remain wrapped up and indoors, so deficiencies do occur, causing rickets in the children. The same deficiency may be found in the poorer suburbs of large cities, where children cannot play outdoors.

Food sources of this vitamin are limited, and the amount they contain is variable. A little is found in fresh milk and some of its products, such as butter; there is some in eggs and in the flesh of some fatty fish; more is found in fish-liver oils.

Vitamin D is now available in its crystalline form of cholecalciferol and can be measured by weight. One international unit of vitamin D is equivalent to 0.025 $\mu$g cholecalciferol, or 1 $\mu$g cholecalciferol has the activity of 40 I.U.[6]

*Toxic effects.* Once fat-soluble vitamins have been absorbed into the body, they are difficult to excrete. Other vitamins do not accumulate because they are water-soluble, and excess amounts are excreted easily through the kidneys. However, if vitamins A or D are taken in excessive amounts, they accumulate, mainly in the liver, and produce nausea, vomiting, and other toxic effects. The usual cause of such excess intake is through overdosage from concentrated commercial preparations; it is not likely to happen in a normal food pattern.

## Thiamine, Riboflavin, and Niacin

The primary action of these vitamins is to break down carbohydrates during energy production and to facilitate the body's use of protein. With adequate intakes of food, the requirement for the vitamins can be related to the requirement for energy. A shortage results mainly in a poor appetite and slowed growth rate. The rich sources of these three vitamins are animal foods, legumes, and whole-grain cereals.

Niacin is available directly from food or it can be converted within the body from the amino acid tryptophan; 60 mg of tryptophan is equivalent to 1 mg of the vitamin. Presumably, the conversion takes place when enough tryptophan is available from proteins. Both niacin intake and tryptophan conversion are taken into account when recommended intakes are expressed as niacin equivalents. Niacin or its precursor are widely distributed in plants and in animal foods, especially meats and milk, and seldom is deficient in the diets of infants and young children. For various reasons, there can be a seasonal deficiency of niacin in adult diets in some countries which depend on maize and, occasionally, on sorghum for their staple food, partly because of factors in those foods that interfere with the availability of this vitamin.[28,29] Perhaps because of traditional processing methods and coffee consumption* Central and South Americans are exceptions, but outbreaks of pellagra are seen in other countries, including some in Europe. It is well to remember that if the family diet is so poor that adults, especially the mothers, are affected, this, like any other deficiency disease, has an indirect effect on young children.

Shortages of riboflavin are more frequent, mainly because the variety of foods and the amount eaten are limited, but the symptoms which develop are

*Hot-water-soluble material from 100g coffee extracted in five minutes contains 27 mg niacin.[30]

not specific. They include cracking and drying of the lips, the skin at the corners of the mouth and in the angles of the nose.

Thiamine deficiency is associated most often with diets that depend on polished rice for the greatest proportion of their energy value. Symptoms of its shortage are more specific, notably by outbreaks of beri-beri. Normally, the nutrient quality of breast milk is not affected by the mother's diet; usually only the quantity is changed. However, a lactating woman on a poor diet may secrete milk that is deficient in thiamine. This could result in infantile beri-beri, which often results in sudden death if the infant is between two and five months old.

Of these three vitamins, niacin is the least soluble and is least affected by heat. Thiamine is the least stable and is most easily destroyed during cooking, particularly if alkaline salts, such as baking soda and lime water, are used. Riboflavin is extremely sensitive to light; although milk is a good source, sunlight can destroy about 80 percent of the riboflavin content of food in two hours.

Intakes for the three vitamins have been related to total intakes of energy,[5] even though it is not strictly applicable to riboflavin and niacin. By virtue of its association with intakes of total energy, the relationship remains the same for each age group and physiological state. The recommended intakes per 1000 kcal are:

| | |
|---|---|
| Thiamine | 0.40 mg |
| Riboflavin | 0.55 mg |
| Niacin equivalents | 6.60 mg |

(see also Tables 2 and 6)

## Iron, Folate, and Vitamin $B_{12}$

These nutrients are essential, along with protein and vitamin C, for normal blood formation. Sometimes they are insufficient in the type or quantity of food eaten in an area. Alternatively, if the diet is bulky and contains too much fibrous roughage, digestion and absorption of food are inefficient, thus affecting availability of the vitamins. Iron and vitamin $B_{12}$ are found in animal-protein foods, especially eggs, liver, and meat. Dried legumes, green, leafy vegetables, and some roots, such as yam, are good sources of iron and folic acid, especially when eaten regularly and in reasonable quantity. Plant foods supply iron and folic acid, but not vitamin $B_{12}$. A completely vegetarian diet has none of this vitamin, though there may be small amounts in some fermented foods.

Usually only some 5 to 10 percent of the iron in food is absorbed by the body; the amount depends on the mixture of foods eaten normally. However, in iron-deficiency anemia and in pregnancy, the proportion efficiently absorbed increases. The requirement for iron is higher in rapid-growth periods when blood volume increases (in early childhood and in pregnancy), than it is at other times.

Folic acid and vitamin $B_{12}$ both dissolve readily in water. Folates are plentiful in green, leafy vegetables and in liver, but are easily destroyed during cooking. A shortage of folate in the diet can cause anemia, and is commonly seen during pregnancy. This type of anemia is more common in tropical countries than is sometimes thought, usually because tests to diagnose it are not always available; it also occurs with iron deficiency.

Recommended intakes for iron are related to the type of diet normally eaten and are based on the amount of absorbed iron needed. Precise knowledge of the iron content of foods and its availability is difficult to find, and the recommendations are the best that can be made at the present time. The recommended intakes shown in Tables 2 and 6 relate to diets in which 10 to 25 percent of energy comes from animal foods and which have an approximate protein score of 70.[6]

## Vitamin C (Ascorbic Acid)

This is one of the most unstable of all the vitamins. It dissolves very easily in water and is destroyed readily during cooking, particularly if there is iron or copper in the cooking utensil. Fruits and vegetables contain substances, including an enzyme, which are not active when the plant is growing. Once the vegetables are picked, cut, or bruised, the enzyme acts on vitamin C and gradually destroys it. The enzyme, in turn, is readily destroyed by heat.

Although vitamin C is so easily broken down frank deficiencies are seldom seen in tropical countries, perhaps because of the variety of fruits that are available. Scurvy does not appear in breast-fed infants, because their intake of ascorbic acid is normally three times greater than that of infants fed a similar amount of other milks. Infants fed on artificial mixtures must have a supplement of this vitamin. It may be given in the form of a selected fruit juice or even as ascorbic-acid tablets, which sometimes are cheaper.

## Water

Water is not ordinarily considered a nutrient, yet it is essential for life. If cow's milk is used for infant feeding, the concentration of the break-down products to be excreted is about four times greater than with human milk. In early infancy, kidneys can excrete urine of only a limited concentration; therefore, an adequate water intake for these artificially-fed infants is essential.

A breast-fed infant regulates its own water supply. When thirsty, it demands to suck, which stimulates the flow of breast milk and results in the baby's taking in more fluid. This is much more difficult if the feeding is artificial. Requirements for water vary with the external temperature. In hot climates, an infant's perspiration losses are high. Then the strength of the feeding mixture becomes even more important in maintaining a balance between the water taken in and the water lost from the body. Sometimes extra water must be given,

rather than extra milk formula. Unfortunately, many communities have not, as yet, a safe supply of water. It is essential, therefore, that only boiled water be used for feeding infants or young children or for cleaning utensils, because of the dangers of gastrointestinal infections.

## RELATIONSHIPS BETWEEN NUTRIENTS

The body's needs for nutrients are all related, and the requirement for one depends on others being present in adequate amounts at the same time. For example, protein utilization depends on energy, which depends on B vitamins; calcium needs vitamin D for bone formation; iron, protein, folic acid, and vitamin C are only some of the nutrients known to be required for blood formation.

Both national and international tables have been constructed, recommending daily intakes for energy and many other nutrients (see Tables 2 and 6). These recommendations are average values and are intended for use when planning diets for groups of people within communities. But they are only guides for any one infant or child, and should not be applied rigidly. The capacity of the body to store vitamins and minerals differs with each individual, and therefore symptoms of their lack appear at different times. Requirements vary according to body size in adults, to physical activities, and to other factors, such as fevers, infections, and parasites. All of these should be taken into account when estimating a suitable level of intake for an individual.

To decide whether a diet is adequate, it is necessary to measure or observe the usual amounts of foods being eaten. If possible, this should be during several days or at regular intervals throughout different seasons in the year or agricultural cycles. Varieties of food used in meals differ on different days, and the total amounts available also will fluctuate. Before or after a market day, or on the day wages are paid, smaller or larger meals are likely to be eaten. This depends on how busy the mother is in preparing and selling her wares or on the money available for buying extra food. Unless some of these aspects of food habits are known, no adequate suggestions for improvement can be made.

To facilitate the study of the amounts of food the children eat, it may be necessary to give infants and small children their food on separate plates, even though the rest of the family eats from a communal dish. However, it should be remembered that interfering with or altering the customary habit of serving the family food might not, in the end, give a true indication of normal food intake,[31,32] and other methods must be found to fit in with the family's traditional meal pattern.

# Chapter 6

# Nutrient Contributions of Various Foods

To appreciate the nutritional value of any mixed diet, some consideration must be given to its individual foods. Obviously, the value of any food depends primarily on how much of it is eaten. It also depends on what else is being eaten at the same time, because, except in infancy, no meal consists of only one food.

As has been pointed out, interrelationships exist between energy, protein, and the various nutrients. Therefore, the quantity of one nutrient that the body absorbs and uses is affected frequently by others present at the same time. A correct diet for infants and children provides both sufficient energy and all other nutrients required for growth, including water for kidney function and the control of body temperature.

Each country has a variety of foods available. The variety is extended further by the traditional methods used in their preparation. For our purposes, all foods can be placed in relatively few groups.

## CEREALS AND OTHER GRAINS

Many cereals are eaten, principally wheat and rice. Maize, the millets—particularly sorghum—oats, rye, and barley follow in approximate order of importance. Tef is used in Ethiopia and quinoa in the Andean highlands.

All cereals have about the same nutrient value, and most form a good basis for a young child's diet. They contain 7 to 14 percent protein, up to 75 percent carbohydrates, and, apart from oats, quinoa, and maize, negligible amounts of fat. Although oats are seldom grown in the tropics, oats or oat products are available in many markets, and the protein value is superior to that of all other cereals. For this reason, a porridge made of oats can be very useful in the diets of young children. The protein percentage (7 percent) in rice is low, but, next to oats, is the best in quality. Rice contains little cellulose and therefore can be absorbed easily.

Dry, whole-cereal grain has no vitamin C, but is a valuable source of thiamine, riboflavin, and niacin; it also contains calcium and iron. Ragi, a finger-seed millet, is rich in calcium; tef and quinoa have more than four times as much as any other cereal. Tef also has by far the most iron. Whole yellow maize is the only cereal that contains carotene, albeit in limited quantities only. In general, maize differs from most other cereals in its pattern of amino acids and its lower niacin availability, but these factors are less important in a well-

balanced diet. In Central and South America, for example, where treating food with lime water is traditional, the low niacin availability of maize is well compensated by the customary consumption of coffee with beans and tortillas.[28,33,34,35]

Basically, however, nutrients in a cooked cereal depend on the initial processing method. Unfortunately, some of those processes, such as refined milling, remove a large proportion of minerals and vitamins, and some proteins.

## TUBERS AND STARCHY ROOTS

These foods form the major ingredients of the diet in areas where cereals are unavailable. Because they are often used fresh and therefore contain more water, the protein content is less concentrated—between 1 and 2 percent. Protein quality of this food group is different from cereals. Protein in potatoes and fresh yams is of superior quality, even though the quantity is less. Because of water content in this group of foods, other nutrients, except for vitamin C, also are less concentrated. Vitamin C is not available from cereals, but is contributed by tubers or starchy roots cooked fresh from the garden or market. Because of the quantities that might be eaten regularly, they are an important dietary contribution.

The potato, widely consumed in temperate regions and also in many tropical areas, is probably the most valuable of this group, followed closely by the fresh yam, taro, cocoyam, and sweet potato, which, if deep yellow in color, is a rich source of carotene. The starchy fruit plantain ranks next in the group, and cassava comes last. Cassava is used extensively in the tropics; it is easy to cultivate and survives when other crops fail. However, cassava is predominately starch, and although it can provide adequate energy, it has little protein (0.5 percent), and that is of poor quality. When cassava or plantain figure largely in the diet, a high incidence of protein-energy malnutrition can be expected. Because people will continue to grow and use these plants, attention must be given to the amounts and kinds of other foods in children's diets. The bulk of a child's meal should also be considered if both energy and protein needs are to be satisfied.

## LEGUMES

Many different kinds of legumes are eaten in traditional diets, and most have similar nutrient values. Their chief asset for young children is the amount of protein they contain; they are also relatively inexpensive. The protein content of dried legumes varies between 20 and 25 percent, and though it is of only moderate quality, it is valuable in supplementing other food proteins, notably the cereals. Depending on how they are prepared, legumes are useful sources of thiamine, riboflavin, and niacin, as well as folate, calcium, and iron. If the bean is bright-red or yellow, such as the lentils, some carotene is also present. A little vitamin C exists in the dried state. When the bean is sprouted, or germinated, the

vitamin C concentration increases and so makes a much greater dietary contribution. Nearly all legumes contain some form of natural toxin, which must be removed by careful preparation. Most toxins are either soluble in water or are removed by evaporation during normal cooking procedures. Some legumes, notably lima beans, must first be soaked and the water discarded before the vegetable is cooked. For young children, legumes must be skinned, well cooked, and finely mashed or ground to make them palatable and digestible.

Most legumes contain little fat, but soybeans and groundnuts are rich in oil and therefore have extra energy value.

Soybeans contain nearly 40 percent protein, which is similar in value to protein from some animal sources. They also contain a large proportion of unavailable starch, which is disposed of by various processing and cooking methods developed centuries ago in Far-Eastern countries. These methods also remove the natural toxins, the bitter taste, and the unattractive gray color that results if the beans are only boiled. Many soy products, such as curds and cheeses, have a higher water content and, therefore, less protein than cooked beans. Nevertheless, they are useful supplements in a rice diet.

Dried groundnuts contain 25 percent protein, but the quality is lower than that of other legumes. This reduces their comparative ability to supplement other foods, especially in a diet of limited variety. However, they are readily available, cheap, easy to use, and welcome in many tropical households because of their versatility as a snack or as part of a main meal. Sometimes groundnuts are affected by a mold that contains aflatoxin, which is acquired either in the fields or during storage. For this reason, they must be checked carefully to insure that only healthy seeds are used in meals for young children. Because of their higher fat content (45 percent), groundnuts are sometimes classified with oil seeds and nuts.[36]

## OIL SEEDS AND NUTS

Oil seeds and nuts usually contain richer and better-quality protein than any of the legumes and, except for cottonseed, less toxin. But they are used less in meals than are other legumes, and their primary contribution is to add a particular flavor, rather than to increase quantity. Although oil seeds and nuts are cultivated extensively, children eat relatively few of them, because oil is extracted from most of the crop and exported. The remaining presscake, still high in protein concentration, is usually fed to animals or used as a fertilizer. Only occasionally is it processed into a product suitable for infants or young children. In a few areas, notably Central America and India, meals from soybeans, cottonseed, sesame, and sunflower seeds, or groundnuts are so processed. Oil of the sesame seed is of special interest. It contains an antioxidant factor that keeps fat from turning rancid. This action is particularly helpful in the tropics, and is utilized in Sierra Leone where ground sesame seeds are added to home-made mixtures for children. Shredded coconut or coconut flour, particularly with the fat removed, contains at least 25 percent good-quality protein and, because it is white, it can be used with rice or other cereal flours, such

as wheat, without affecting its acceptability. Coconut protein can supplement other proteins in the child's diet.[36,37a,b,c]

## VEGETABLES

The FAO food-composition tables for Africa list about 400 varieties of vegetables.[38] The leaves, roots, stalks, flowers, or fruits of many of the plants or all can be eaten. As a group, they have high water content and thus low energy value and little protein. They contain various amounts of cellulose fiber, which add bulk to meals. As we have said, this can be a disadvantage for infants or young children, because their digestive system cannot extract the nutrients from large amounts of this food. Nevertheless, vegetables are most important for the flavor and interest they add to meals. They are also sources of minerals, such as iron, and vitamins, particularly the carotenes, folate, and vitamin C. The darker the color, whether it is green, red, or yellow, the richer the vitamin-A value. They contain only small amounts of thiamine and other B vitamins, but, if prepared well, they are valuable supplements. When immature legumes, such as fresh green beans, are eaten, their nutritive value is similar to that of other vegetables, because their protein content has not yet accumulated.

Dark-green leaves, including spinach, or cabbage are common to every tropical country, and in rural areas can be gathered free or cultivated easily. Tomatoes, onions, sweet peppers, green mangoes, pumpkins, carrots, "ladies-fingers" or okra, eggplant or brinjal are just a few of the vegetables available for meals as the seasons permit.

## FRUITS

The nutritive value of fruits is similar to that of vegetables but, because they have a sweeter taste, they generally are eaten raw, and this is an advantage. Fruits can be taken as snacks between meals, and children should be encouraged to do so. Instead of starch, as in vegetables, fruits contain mixtures of easily digestible sugars. Many tropical fruits are excellent sources of vitamin C, and the more highly colored, the greater their carotene content. The citrus varieties, papaya, mangoes, and guavas are inexpensive, and other fruits are readily available at different seasons. Berries grow best in temperate climates. Raw rosehips and black currants supply vitamin C and retain a good part of it when cooked, because of the acids they contain. Tomatoes are similar in this respect. The avocado pear is one of the few fruits containing fat, increasing its energy value.

Interestingly, dried fruits, such as dates, figs, or raisins, yield more concentrated nutrients than do fresh varieties. They may contain six to 10 times as much energy, a great deal more calcium and iron, about 4 percent protein, and often some carotene, but no vitamin C. In some areas, dates are a major source of energy, and their high sugar content acts as a preservative.

Ackee, a fruit commonly eaten by children in Jamaica, must be used with some care. Only mature ackee should be eaten; if it is unopened, bruised, or damaged, its toxin can cause uncontrolled vomiting in small children, particularly if they are undernourished. The initial stymptoms may be followed by convulsions and coma. The toxin is water-soluble and the water the fruit is cooked in should be thrown away.

## FOODS OF ANIMAL ORIGIN

As a group, foods of animal origin are important for young children. They contain a good proportion of high-quality protein, which makes them excellent supplements for cereals and other staple foods. Although comparatively expensive and sometimes in short supply, they are economical in small quantities, especially if legumes are used in the same meal. They are digested readily and are almost completely absorbed by the body, in contrast to most of the plant foods that contain protein. Foods from animal sources are unique in providing vitamin $B_{12}$.

### Milk and Milk Products

Milk of many animal species is fed to children.[27] Cow's milk is probably the most widely used, but in many tropical countries milk from buffaloes, goats, and sheep is used. Table 5 shows some nutrient differences between human milk and cow's milk. Milk from various species and some milk products are compared, both per 100g and per 100 kcal, in Table 8. Analyses per 100 kcal are shown because milk is often given in a quantity to satisfy energy needs, and this Table indicates the differences in the other nutrients supplied at the same time.

Apart from the species differences, a certain similarity exists in the nutrient composition of all milks. All provide high-quality protein, and fat and sugar, as lactose, are present in varying amounts. Lactose is most concentrated in human milk. Milk from buffalo and sheep contains almost twice as much fat as other fresh, whole milks. All milk fats contain vitamin D and some vitamin A and carotene, though in different ratios. Milks are also rich in the B vitamins, especially riboflavin. Goat's milk, however, contains little or no vitamin $B_{12}$, and for this reason is not suitable as the sole food for infants, even when it is clean and from a healthy animal. Human milk contains three to four times as much vitamin C as the others, and provides enough for the infant; other milks generally have amounts inadequate for humans. Milk is a rich source of calcium; although human milk contains less than some others, it is used more efficiently by the infant than is calcium from cow's milk, which contains four times as much. Milks are poor sources of iron.

Milk from even a healthy animal is highly perishable, particularly in the tropics. It must be handled with care to keep it safe for consumption. Traditionally, milk can be preserved in different ways, three of which are heat

treatment, removal of water, or souring with a lactobacillus. Most preserved products retain much of their nutrient value, but there are a few notable exceptions.

***Dried milks*** are of two major types—whole and skimmed. Both the water and fat have been removed from dried skimmed milk, together with vitamins A and D. This product stores better without the fat, but unless these vitamins are

TABLE 8. COMPARISON OF SOME NUTRIENTS IN VARIOUS MILKS PER 100g

| *Milk or Milk product* | *Energy kcal* | *Protein g* | *Fat g* | *Carbo-hydrate g* |
|---|---|---|---|---|
| Human | 67 | 1.2 | 3.8 | 7.0 |
| Cow | 66 | 3.3 | 3.7 | 4.8 |
| Sheep | 108 | 5.6 | 7.5 | 4.4 |
| Buffalo | 102 | 3.8 | 7.5 | 4.9 |
| Goat | 71 | 3.3 | 4.5 | 4.4 |
| Dried skimmed | 357 | 36.0 | 1.0 | 51.0 |
| Dried whole | 500 | 25.5 | 27.5 | 37.5 |
| Evaporated, unsweetened | 140 | 7.0 | 8.0 | 10.0 |
| Condensed, whole, sweetened | 317 | 7.3 | 8.0 | 53.9 |
| Condensed, skimmed, sweetened | 276 | 9.6 | 0.3 | 58.8 |

PER 100 kcal

| *Milk or Milk product* | *Quantity* | *Protein g* | *Fat g* | *Carbo-hydrate g* |
|---|---|---|---|---|
| Human | 150ml | 1.8 | 5.7 | 10.4 |
| Cow | 152ml | 5.8 | 5.6 | 7.3 |
| Sheep | 93ml | 5.3 | 7.1 | 4.3 |
| Buffalo | 98ml | 3.8 | 7.4 | 4.9 |
| Goat | 140ml | 4.6 | 6.3 | 6.2 |
| Dried skimmed | 28g | 10.0 | 0.3 | 14.3 |
| Dried whole | 20g | 5.1 | 5.5 | 7.5 |
| Evaporated | 71g | 5.0 | 5.7 | 7.1 |
| Condensed whole | 32g | 2.3 | 2.6 | 17.2 |
| Condensed skimmed | 36g | 3.5 | 0.1 | 21.2 |

(Adapted from: "Milk and Milk Products in Human Nutrition" 27)

replaced, it is not suitable for feeding to infants. The absence of these vitamins in milk is a minor problem only if the diet contains a wide variety of foods.

*Evaporated milks* are usually full cream and differ from fresh milk only in the amount of water they contain.

*Condensed milks* contain a high concentration of sugar (45 percent by weight) and they may be full cream or low fat. The high sugar content reduces the protein per unit weight and makes the milk highly unsuitable for infants and young children. If it is fat-free, it also lacks vitamin A or D.

*Yogurt* is a curd product formed by acid produced through the action of a lactobacillus on the lactose. The acid also acts as a preservative. If care is taken to control the amount and kind of bacillus used to make it, yogurt is a comparatively safe food. Its nutritive value is similar to that of fresh milk.

*Cheese* also is a milk curd, but most of the water has been removed, which makes it easier to store. Soft cheeses retain some water and are similar in nutrient value to simple curds. In harder cheeses, the soluble protein, nearly all of the lactose, and 75 percent of the thiamine and riboflavin are lost in the whey when it is separated from the curds during cheese-making. Cheese such as this is approximately one-third protein, one-third fat, and one-third water. If made from whole milk, it contains vitamins A and D and most of the original calcium, combined with the protein curd.

Curds and, especially cheeses are a convenient way to preserve milk in a hot climate. The "lost" whey contains most of the soluble proteins and lactose, the greater proportion of the B vitamins, and a small amount of calcium, all of which could supplement the diets of children.

*Butter or ghee* are the fractions of milk that contain fat but no protein. Because of the fat, they have vitamins A and D in variable amounts, depending on what the animal has been fed, the season of the year, and the processing method. Butter and ghee increase the energy value of some of the food mixtures for children (see recipe chapter) without increasing the bulk.

## Meats

All meats are fine sources of protein, the B vitamins, particularly niacin, and iron. Meats from young animals contain more water and less fat than do the more mature products; however, the protein percentage is the same. Raw meat contains about 16 percent protein. The energy value depends on the amount of fat and the cooking method. Fresh liver contains vitamin C and, because it stores the animal's reserve nutrients, it is a rich source of iron, the B vitamins already mentioned, folate, and vitamins A and D. Poultry has a nutrient value similar to that of meat. It usually has less fat, but ducks and other water birds often contain a great deal more than does meat. The more unusual sources of protein, such as the bush animals, snails, locusts, and flying ants, are also good additions to the diet, even though the amounts eaten may be small.

Because of the differing standards of meat inspection in abattoirs and the possibility of helminthic infections, all meat should be well cooked. To help very

young children digest and absorb meat, it should be cut finely. The values of tinned meats are similar to those of fresh-cooked meats, and tinned meats are convenient to purchase, store, and use.

### Fish and Other Seafoods

In food value, fish is similar to meat, but has less iron. Mussels, shrimps, and prawns have abundant iron. The livers and flesh of oily sea fish, such as herrings and sardines, are rich in vitamins A and D. Unless the fish have been heavily smoked and dried, their proteins are excellent. Like meat, fish can be absorbed completely and is digested even more easily. Unlike meat, fish contains considerable amounts of calcium when eaten with the small bones: such varieties as anchovies, sprats, or sardines are frequently prepared and eaten whole. Canned sardines, available in many places, are easy to carry and store.

### Eggs

Eggs are another food that a child can digest and absorb almost completely. Its protein is of excellent quality, its fat well-tolerated, and it is a source of vitamins A and D. Eggs contain only minute amounts of starch, and they are good sources of thiamine and riboflavin. The protein and ease of digestion make eggs an excellent supplement in meals for infants and young children. Unfortunately, in many societies in all parts of the world, infants and small children are not permitted to eat eggs because of local customs or taboos, or because the eggs are sold as a cash crop. Egg consumption should be encouraged. (Note: The custard powder bought in the market has no connection with eggs; it is made of starch and is artificially colored. Any value is in the milk, if that is used to prepare it.)

## FATS AND OILS

Fats and oils are very compact forms of food. They add to the energy value of the meal and to its palatability, although the amounts eaten each day vary widely according to traditional cooking patterns. Most fats that are solid at room temperature are from animal sources and contain predominantly saturated fatty acids. All fats contribute a concentrated form of energy to a meal.

Plant-seed oils are usually liquid, and contain more of the unsaturated fatty acids. Apart from red palm oil, which is rich in carotenes, plant oils have no vitamins, but they do contain some of the fatty acids that are considered essential for life. Two exceptions are coconut oil, one of the few plant oils to solidify in temperate climates, and olive oil. Like animal fats, they contain a high proportion of saturated fatty acids, but very few of the essential unsaturated fatty acids.

Red palm oil is available in several parts of the world, yet a high incidence of blindness due to vitamin-A deficiency, is common in some areas where the oil is exported for cash. Children should become accustomed to this oil and its flavor at an early age.

## SUGAR

In refined form, sugar contributes only energy. It has no protein, no vitamin, no mineral value. Its two advantages are its concentrated energy, though it is less than that in fats, and its ability to reduce the bulk of a meal for a child.

Sometimes sugar is added to an infant's food in unnecessarily large amounts because the mother likes the taste. Sugar, like oils, may dilute the concentration of protein in the meal (see Chapter 12). Small amounts eaten at the right time in a good, mixed diet will do no harm. However, evidence does show that a high consumption of sugar increases the incidence of dental caries in children, particularly if sweet foods are consumed frequently throughout the day, thus reducing the appetite for normal meals. Overconsumption of sugar or foods containing it can lead to obesity, another form of malnutrition. Once obesity is established in childhood it often continues into adult life, creating its own problems. A liking for sweet foods should not be established during infancy.

## HERBS, SPICES, AND CONDIMENTS

These substances taken in food or drink may not have any particular nutritive value, but they do add flavor and increase the pleasure of eating. By doing so, they encourage an adequate food intake. Most spices are used in such small quantities that any nutrients they may have make only a negligible contribution to the diet. Curry spices contain calcium, and ginger root contains thiamine, but their dietary value depends on the amounts eaten. Chillies, fresh or dried, if used regularly in meals, can make an appreciable contribution to the carotene intake.

Some caution must be used when adding strong flavors to food. Although they encourage adults to eat foods that would otherwise be considered dull or unpalatable, they often have the opposite effect on young children, particularly those who have sore lips or mouths. In these circumstances, highly spiced food becomes painful and very likely will be rejected, and any decrease in food intake aggravates the condition of a child who already is poorly nourished.

# Chapter 7

# Food Processing and Its Effect on Nutrients

Food processing, including cooking, is of ancient origin, and often the method used in a country is a distinguishing feature of its traditional culture. There were many reasons for the development of processing methods. Among them were the necessity to reduce bulk and increase digestibility; to develop flavors, change the appearance, and improve palatability; to give variety to foods in daily use; and to prevent deterioration during storage and transport. In addition, processed foods can be saved from times of plenty for use in times of shortage.

The purpose of food preservation methods is to destroy bacteria and to slow enzyme action. This can be accomplished by raising or lowering temperatures, by removing water, or by adding preservatives, such as acid, sugar, or salt. Traditional methods still in use are drying, salting, and smoking. Often these are done as a home or village activity, with canning and freezing as a rural industry or part of a commercial effort. Modern processing methods cover an extremely wide field, but here we will discuss only those that can be accomplished in the home or by a local community effort.

Most foods, apart from fresh fruits and some vegetables, are processed before being eaten. They may be washed, soaked or cooked, preserved and stored, sprouted or fermented.

All these processes alter the original nutritive value in either a positive or a negative way. The extent of any change is variable, and depends on the type of food, the process used, the length of time and the temperature involved, and on the nutrient itself. Losses may be physical, as when the germ of the cereal is removed in the flour-making process, or when potatoes are peeled and the skin discarded. Losses may also be due to chemical processes, as when alkaline salts are used when cooking green vegetables, so destroying the vitamins.

Methods for processing the important staple foods should be examined carefully to assess the losses that might occur. Any decrease in nutritive value can be amended in one of two ways: by improving the method or by including other foods that compensate for the losses. Improvements can be simple. For instance, reducing the length of time foods are soaked; avoiding overdrying in direct sunlight; cutting cooking time at high temperatures; or eliminating use of alkalis and other substances during processing or cooking.

## STORAGE

Improper storage can result in considerable food loss if facilities are not available to control insect or rat infestation, temperature, humidity, and undue access of air. In addition to a decrease in energy value, protein and fat will break down and, depending on the degree of milling, vitamins, particularly thiamine, can be lost. Similar losses occur in legumes. In markets at the end of the season, the loss in weight of cereals and legumes caused by the ravages of insects is most noticeable. Where these foods are sold by volume instead of by weight, value for money by any standard is reduced greatly.

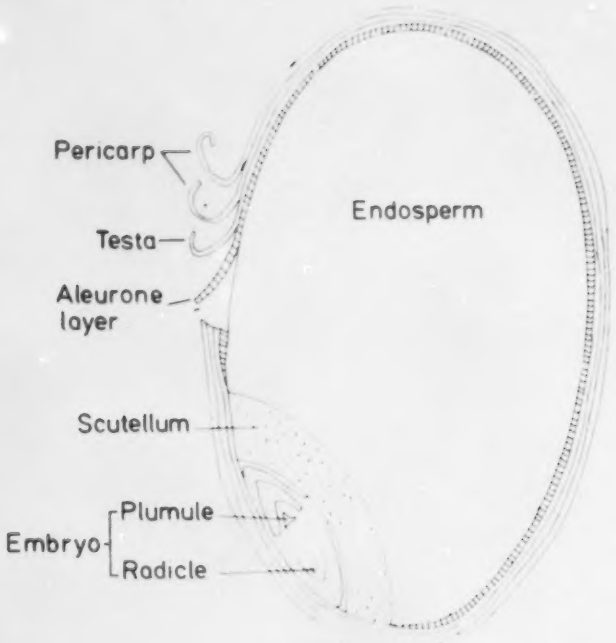



Figure 17. Diagram of longitudinal section of a cereal grain.

## MILLING

Except for rice, most cereals are milled to a flour before use. Some knowledge of the general anatomy of the grain and the distribution of its more important nutrients allows a better understanding of the effects of this process. The diagram in Figure 17 shows a longitudinal section of cereal grain.

The nutrients are not evenly distributed in the grain. Some outer layers, the scutellum and, especially, the germ, have the greatest concentration of B vitamins, iron, and calcium. Because of this distribution, shown in Table 9, and because many milled flours retain little more than the endosperm, the probable nutrient losses become evident. The degree and manner of milling is of great importance in areas that rely on cereals as the major source of dietary energy.

TABLE 9. PERCENTAGE DISTRIBUTION OF SOME NUTRIENTS IN A CEREAL GRAIN[39]

| | *% by weight* | *Thiamine* % | *Riboflavin* % | *Niacin* % | *Protein* % |
|---|---|---|---|---|---|
| *Layers* | | | | | |
| Pericarp and seed coat | 8 | 1 | 5 | 4 | 4 |
| Aleurone | 7 | 32 | 37 | 82 | 16 |
| Scutellum | 1.5 | 62 | 14 | 1 | 4.5 |
| Germ (embryo) | 1.0 | 2 | 12 | 1 | 3.5 |
| Totals | 17.5 | 97 | 68 | 88 | 28 |
| Endosperm | 82.5 | 3 | 32 | 12 | 72 |

*Commercial milling:* Yields flours that might vary in consistency and content from a coarse whole meal to one devoid of outer layers, germ, and scutellum. The refined flour has little fiber, thus improving digestibility; it contains no fat, so it can be stored for longer periods, given reasonable conditions; and it is white in color. However, this flour has lost a great deal of nutrient value—energy, protein, vitamins, and minerals—because only about 55 percent of the grain may be left in the flour.[40]

*Dry milling:* A rural household process producing a flour from whole grain, which may or may not have been cleaned. If not, the flour is both gritty and coarse, factors that limit the amount that can be eaten. A faster passage through the intestine, makes the flour difficult to digest efficiently and the nutrient absorption is incomplete.

*Home pounding:* To ease the work, the whole grain usually is dampened before being pounded. In a warm climate, some fermentation might begin, thereby improving vitamin values. However, the method is laborious and time-consuming, and gradually is being abandoned in favor of the village mill.[41]

*Wet milling:* In many African countries, the grain is soaked in water before going to the mill, sometimes for two to three days, when flavor is said to be improved because of some fermentation. After the milling, the wet flour might be washed several times to remove all visible debris and to produce a white flour. Significant amounts of protein, about half the minerals, and considerably more of the B vitamins are lost by this method.[42]

Traditionally, alkaline lime water is used in Central and South America to soak and soften the maize before it is ground. This increases the calcium content and makes niacin more available, but, because of the solubility, some of all the B vitamins are lost, particularly thiamine.[28,43]

Rice rarely is ground to a flour. It usually is pounded lightly or milled and polished into a highly refined product that has lost its nutrients in the same way as other cereals. Customarily, rice is washed before being cooked, sometimes many times. When the grain is soft, the excess liquid is thrown away and, with it, still more of the water-soluble nutrients. Losses can be reduced by limiting prewashing and insuring that all the cooking water is absorbed by the time the rice is cooked and ready to eat.[34]

## PARBOILING

Parboiling has been developed as a method to preserve cereal nutrients. More than one-sixth of the total rice consumed is parboiled and, in Middle-Eastern countries, some wheat is processed in the same way. The grain is soaked, steamed, and dried carefully. During the soaking, nutrients from the germ are absorbed with the water into the inner part of the grain, and the germ becomes attached more firmly during the drying process. Because of this process, the grain loses less of its nutrients when it is milled. In addition, the heat used in drying hardens the outer coat. This is an advantage, because it results in the grain being more resistant to insect invasion and more suitable for storage than cereals processed by other methods. As a result, the rice is cleaner, requires less washing before use, and losses of the B vitamins can be reduced considerably. If all water used in cooking is absorbed by the grains, even fewer nutrients are lost.

## REFINING

This involves additional processing at the time of milling. Whole cereals lose vitamins, proteins, and other nutrients when they are refined. This is particularly dangerous in areas where cereals comprise virtually the whole diet. The vital, lost nutrients must be replaced. The best sources of the lost vitamins are in foods from animal sources, but these may not be available in sufficient quantity or may be too expensive to buy. Legumes are a good substitute, but must be eaten in adequate amounts.

## TRIMMING, WASHING, SOAKING, AND BOILING

These processes mainly affect tubers, starchy fruits and roots, vegetables, and legumes. Physical losses through peeling must be balanced against increased palatability and digestibility. In areas where food is in short supply, the wastage usually is minimal. Carotene will be lost if many of the outer, dark-green leaves are removed. As with cereals, there will be nutrient losses during washing and soaking, but the extent will depend on the number of washings, the amount of water used, and the length of soaking time.

Soaking cassava roots or legumes removes certain natural toxins that are water-soluble and easily destroyed by heat. Sometimes cassava leaves and other similar products are pounded before cooking. In addition to breaking down coarse fibers, this usually removes toxins, and is of greater importance than the preservation of vitamin C, which is available from other sources.

Many traditional meals are cooked in pots over open fires and, as a general rule, the longer the cooking time the greater the destruction of thiamine and vitamin C. The Far-Eastern method of immersing the vegetables in hot oil and then adding a small quantity of water, all of which is absorbed, preserves maximum nutrient value.

## SPROUTING AND FERMENTATION OF LEGUMES AND OTHER FOODS

In many places, legumes are germinated until they sprout or are fermented. These practices can improve nutrient value and digestibility and, as we have said, can destroy natural toxins at the same time. The legumes most often sprouted are chick-peas, green grams, and soybeans. Vitamin C is synthesized during germination and, depending on the legume, different concentrations can be obtained. The amount of riboflavin is increased at the same time. Sprouted legumes, a regular ingredient in some traditional meals, also are extremely valuable in times of famine. They can be eaten raw, but it is important that the shoot itself be eaten together with the grain. Despite its concentration in the tender shoots, much of the vitamin C is lost during cooking.

In certain warm, humid climates where there is a scarcity of fuel, food-drying is not practical, so fermentation is a common method of preservation. Digestibility is improved and appetizing flavors are developed. Soybeans and groundnuts are fermented, either by themselves or with rice or wheat, to make sauces, pastes, and cheese. In West Africa, the locust bean is fermented and used as a flavoring in soups and stews. In India, fermented foods such as idli or dosai are commonly made with rice, often parboiled, and black gram. Farther east, especially in Indonesia, soybeans, groundnuts, and sometimes coconuts are fermented by a special fungus into tempeh.

Microorganisms synthesize enzymes, which break foods down into simpler, more water-soluble substances. Proteins are broken down to amino acids; starch is converted to sugars; riboflavin and niacin contents increase; some vitamin

$B_{12}$ appears; methionine increases; and there seems to be some increase in the amount of available iron.[36]

Traditional fermentation methods are often done in two steps, because the conditions that encourage the growth of the microorganisms do not produce a food that keeps well. A second step may include drying, adding salt, controlling ventilation and temperature, or a combination of these to make a storable product. The value of these foods depends on the original ingredients. Legume products, alone or with cereals, have a high protein content, affected only by the amount of water they contain. Soybean curd has a smaller amount of protein than do the drier pastes. The dietary value of some products, such as soy sauce, is limited by a high salt content, which restricts the amount that can be eaten at any one time, but they provide flavor and encourage the consumption of more of what otherwise might be a bland, monotonous diet.[36,44]

Other foods also are fermented. Small, whole fish are fermented either alone or with cereals and salt. The fish are made into sauces or pastes that contain the more soluble proteins plus the calcium in bones. Eaten as condiments, flavored with curry spices or peppers (for adults), they are good sources of amino acids, particularly lysine.[45]

Milks, as we have seen, are fermented to yogurt in many hot climates, making a food equal to fresh milk in nutritive value. Milk may be fermented by itself, with or without the addition of sugar, or it may be combined with a cereal, then dried and stored. Kushuk, an Iraqi mixture of parboiled wheat and yogurt, is sun-dried after fermentation, then ground to a powder before being stored. Although large increases of riboflavin and niacin develop during fermentation, sun-drying destroys at least a third of the riboflavin formed. To prevent maximum loss, the product should be shaded from direct sunlight during the drying process.

Vegetables are fermented to produce the sauerkrauts of Eastern Europe and kimchi, traditional in Korea. Salt, spices, and other flavorings, including fish, may be added to the vegetables. Some thiamine and vitamin C may be lost, but as the vegetables are eaten raw, their nutrient content is better than it would be if cooked.

## OTHER PROCESSING METHODS

### Vegetables and Fruits

Sun-drying is an ancient process. If the foods are first plunged into boiling water and then dried away from direct sunlight, carotene, thiamine, and vitamin-C losses are reduced. Sulphites, sometimes used to preserve color, destroy most of the thiamine. In areas where fruits and vegetables are dried, inexpensive air driers can be used on a village scale under controlled conditions of temperature and humidity.

Canning of fruits also can be done on a community basis, and the resulting products are similar to good, home-cooked food. Canning vegetables requires considerable care, as more heat is needed to penetrate the denser tissue. Unless properly prepared, some home-canned foods can cause serious illness and even death.

## Meat and Fish

To hasten the drying process, meat and fish usually are salted. If subsequently air-dried, as in Iceland or Scandinavia, some vitamins may be lost, but the protein value changes little. Dried salt cod is an excellent product that stores well. In damp climates, additional heat is often necessary, so smoking may be part of the drying process. If too intense, heat can cause the protein to brown (Maillard's reaction), changing some of the lysine and other amino acids and reducing the amount of available protein. Vitamins, particularly thiamine, also are affected. Smoking does impart popular flavors and reinforces the preservative action of the salt, but often it can be done just as effectively with less heat.[46,47] Unfortunately, some traditional dried meat products, such as biltong, charqui, or dried smoked fish, have disappointingly low protein values.

Another household method for preserving meat is to fry small pieces in fat for a long period. The cooked meat is partially dried and stored, with or without spices and pepper, in jars sealed with fat. Such foods are successful if cool storage is possible. Some thiamine is lost, but the valuable protein is preserved.

Meat, fish, and other foods can be dried for a whole village by using a vacuum oil technique. The principle is similar to that of the more expensive, accelerated freeze-drying process, and nutrient changes are negligible. The food is fried in oil at 70°C and the water vapor is extracted under vacuum. If kept in air-tight containers, these products can be stored satisfactorily at ordinary temperatues.

If facilities are available, foods such as fish can be preserved by freezing. Temperatures of -20°C must be achieved quickly, and this is best done if small pieces of food are used. Slow freezing cause large ice crystals to form, and these distort muscle fibers and break down cell walls. As a result, there is considerably more "drip" when the food thaws, so larger amounts of soluble proteins and vitamins are lost.

Meat and fish also can be canned. Higher temperatures are required than those for vegetables or fruit, so slightly more thiamine is lost.[48]

## Milk

Because milk is a liquid with many nutrients, it contaminates easily by virtue of swift bacterial growth. To be safe for children, processing methods are essential; some of these methods have been mentioned already. High standards of hygiene for those who handle and treat milk are extremely important, as is the health of the animal and the milker.

If the milk is left in strong light, the first nutrient loss is some of the riboflavin. Milk for infants and small children should be boiled, even though it results in a small loss of calcium, fat, and protein in the milk skin and the deposit formed in the pan. However, harmful bacteria are destroyed and the protein is altered so that a softer curd is formed in the infant's stomach. Depending on

how long the milk is boiled, some thiamine is lost and the sugar (lactose) becomes more concentrated as the water evaporates.

No matter how well milk has been treated to make it safe for infant feeding, it can be re-infected unless great care is taken. Even dried milks deteriorate. They must be stored in clean, airtight containers in a cool, shady place, particularly if they contain fat. Unless water supplies are safe, it is better to add powdered milks to cooked foods, rather than using them as a drink. Once opened, tins of evaporated milk also will become infected by airborne bacteria and dirty hands. For safety, tins of milk should be bought in sizes that can be consumed fairly quickly. Under no circumstances should sweetened condensed milk be used for very young children because of its high sugar content. This points up, once more, the value of breast feeding.

# Chapter 8

# Nutrition Education

## APPROACH TO TEACHING

If the nutrition of infants and young children were improved, especially during the first year of life, death rates could be reduced drastically. However, raising the standards of child nutrition cannot be done in isolation. Food problems are closely related to over-all health problems, and neither can be separated from the environment of the home.

Although preparation of meals is a practical task and the facilities may be simple, many influences affect the quality and the other characteristics of meal prepared. The cost of food, its origin, its availability, the food choice of the mother, the fuel and utensils, and the free time she has from other work, all affect the type of meal she prepares. The mother herself may or may not decide on the foods to be used, and the number of times she cooks each day often depends on her husband's work. The distance he has to travel and the facilities he has for eating out will probably decide when the main meal of the day is served.

Local customs and beliefs have a further influence on meals. Unfortunately, these beliefs often limit the use of eggs, fish, or meat in children's diets.

Kinship systems, though they have certain advantages, can create problems. Young parents with some education may be prevented from making decisions on the feeding of their children because such decisions are made by the grandmother.

The persuasive influence of television and radio is strong, and illiterate people, even though intelligent, cannot read for themselves to assess the value of advertised products. The status given to some foods often is not justified.

Frequent pregnancies, especially in the lower income groups, may cause the mother's health to suffer and put a strain on the resources available to feed the family adequately. Planned parenthood can help this situation.

Young children become sick for many reasons, but often their illnesses can be traced to polluted water, disease-bearing flies, dirt, and inadequate or unsafe food storage. Also, accidents are common, because cooking fires are too accessible to the toddler.

These are just a few of the problems in the home environment that affect the diet, and they must be considered when plans are being made to improve the standards of infant and child nutrition.

Many developing countries suffer from a lack of trained medical personnel, particularly doctors. Therefore, the people who are trained must delegate responsibility for collecting information that will form the basis of an over-all plan for health and nutrition education in a country or region. This teaching plan should be interpreted at each level of staff down to the auxiliary working with mothers in the village. The basic teaching principles must be coordinated and consistent throughout the area. If personnel move from one clinic to another, they must use the same basic facts in their lessons.

Health-service facilities may be hospitals, rehabilitation clinics, health centers, dispensaries, or mobile medical units. Hospitals often are few in number, but integrated health centers have been established in many places. Unfortunately, much of their work is, of necessity, curative, leaving trained staff little time to devote to education. Other workers are needed, either to help take over some of the routine clinic work or to be trained in preventive community work as an extension of the local clinic, under its supervision.

Personnel for education differ in each country. Some places have trained nutritionist-dietitians, with assistants, but they are few in number at present. Nurses, health visitors, home economists, community nurses, midwives, and auxiliaries are trained by the Health or Agriculture ministries. Local women or girls in their late teens have been taught to do simple teaching in their villages. Basic training is needed at all levels, and wherever possible this should be extended to short, but regular, refresher courses. Such courses encourage the staff and auxiliaries, bring them up-to-date, and coordinate teaching. The more they understand all aspects of the work, the more persuasive they can be in their dealings with mothers and children. With exchange of ideas through discussions, the staff becomes more flexible and better able to suggest alternative ideas to the women they go back to teach.

In an agricultural community, education should not be limited to mothers or grandmothers. Fathers, often farmers, should be encouraged to join in any teaching program. They may have more interest in their crops if they realize how important they are for their children and are shown how the yield may be increased for consumption, for preservation, or for marketing.

In urban areas, housing and cooking facilities may be extremely poor. The mothers may go out to work and the available market foods may be unfamiliar, and expensive. These problems form the basis for teaching the mothers at a time when they are free to join in some community group.

The success of teaching depends on the personality of the teacher, as well as on her training. She must be firm but sympathetic and have a sense of humor. She must be prepared, and appear to have time, for a chat with each mother so she can become familiar with individual problems.

The timing of any class should be convenient for the mothers and may coincide with clinic visits or some other community gathering. The setting for the class should be comfortable and relaxed, to encourage questions and discussion. Often a class can be held outdoors, sheltered from the strong sun and where everyone can hear and see what is being demonstrated. The group should be kept small. A series of short demonstrations for 10 to 12 mothers is much more satisfactory than a longer one for more people (Figures 18 and 19).

Figure 18. Nutrition Education: Lesotho.

Figure 19. Nutrition education in Ethiopia. Mothers are more attentive if allowed to sit comfortably in small groups. Overcrowding should be avoided.

The points made in the lesson should be few, but they should be simple and clear. They will be remembered more easily if they are related to something already familiar to the mothers.

The lesson should be short, because mothers with small children cannot concentrate for long and may be some distance from home. Their interest should be attracted right from the beginning, perhaps by asking questions about their homes, their families, or their last visit. Whenever possible, one of the mothers should be asked to assist in the teaching. This may be particularly convincing to others if she herself has had a malnourished child who has improved on "village foods" only. Often such mothers are eager to teach others about what has helped her and her child.

Any demonstration should be in terms of foods and utensils with which the mothers are familiar, and which are within their means. Foods should be those they can produce on their farms or in their gardens. Better budgeting of food supplies should be taught to insure enough food from one harvest to the next. It should be pointed out that the temptation to sell the main crop of beans at favorable prices after harvest is not wise economically, if later in the year some must be bought back, probably at a higher price. Mothers in urban areas should be given guidance on how to budget their money and how best to spend what is available for food.

Traditional pots, clay or iron, should be used for cooking demonstrations on a stove or stones with whatever fuel is normally used. Stainless-steel pots or sophisticated stoves are unrelated to the mothers' home circumstances. Families and communities should be encouraged to build on and extend the best features of their own way of life.

If diarrheal diseases are common, teaching should emphasize the hygienic aspects of handling food. Care of feeding utensils, storage of raw, prepared, or preserved foods, and the control of animals that might wander into the house must all be included. If a vitamin deficiency is common, stress should be given to using foods that contain it.

In many places, supplementary foods are distributed to mothers and preschool children. The distribution center usually is a clinic, which should use the foods as part of the education program. Mothers should be taught why and how to use the rations, particularly if some of the ingredients are unfamiliar. Such teaching is even more effective if the mothers can taste the cooked product at the end of the demonstration.

Results of teaching can be tested by inviting a mother to repeat a demonstration for others at a later session. Follow-up teaching can be done informally during home visits as part of the preventive plan (Figures 20 and 21).

However, education need not always be in groups. It can be conducted informally with an individual at home, in or out of a clinic, or at some other meeting place. Examples set by auxiliary or other health workers can themselves be a continuation of teaching.

Figure 20. Home visits as an important integrated part of MCH work.

Figure 21. At home visits, habits can be studied and discussed; in this case bottle feeding in Sarawak.

## TEACHING AIDS

The choice of teaching aids should be highly selective; their use is primarily to reinforce the points being taught. Posters are not helpful if they are used only as decorations on clinic walls. To be really effective, they must be designed with great care, using symbols that can be part of a lesson and cannot be misinterpreted in a specific community. One really good poster can be a link that connects the teaching done in all the clinics. Printed materials obviously are of use only if they can be read and understood.

Flannel boards can be successful because mothers and older children can participate in using them. However, the size, color, and contrast of the pictures must have a direct connection with the local situation and available foods. Good pictures or photographs may be understood more easily than line drawings, and they can be used if it is not practicable to have real food at the lessons.

Films and film strips are helpful if the audience is accustomed to mechanical devices, but too often attention to the lesson is distracted by the movement and color.

Whatever the aid used, it must be a specific part of the lesson and be included in any discussions that follow. At each class, mothers should be reminded of what was taught at previous sessions, and any education program should be followed up in order to judge its success. If results are disappointing, the general approach to the mothers and the teaching program should be reconsidered and replanned.[49,50]

## NUTRITION REHABILITATION UNITS

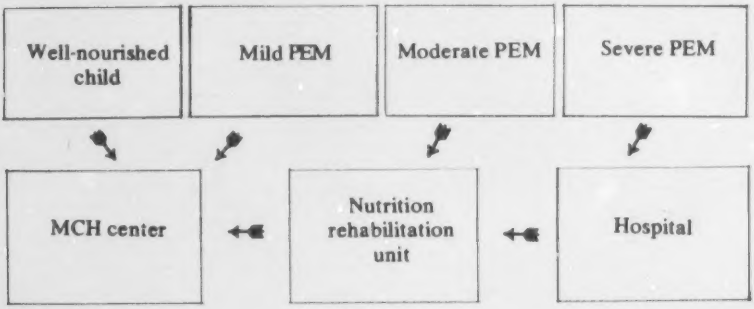
Many such units have been started in developing countries in the last few years. They have been planned in different ways, but all of them provide excellent opportunities for nutrition teaching. Only day-care is offered at some units. This could be impractical, because of the mother's work at home and her responsibilities to others in the family. In other types of units, the mother and her child can live for varying periods—two to three weeks or even longer—and in some others both types of care are combined.

Alternatively, a unit might be organized through daily sessions as part of the hospital outpatient service. Mothers could bring their children regularly, but how often would depend on the stage of recovery from PEM and the distance to be travelled from home.

Rehabilitation units usually are located close to a hospital or a health center. The buildings are simple. Some are mud houses, but with various improvements that are within the means of most local families. Some have such amenities as a raised fireplace, a soak pit, latrine, or compost heap. Some have a vegetable garden or a simple arrangement for raising poultry and producing eggs for the center.

Some infants and children at such units have been hospitalized for severe malnourishment and sent to the unit to recuperate. Others with moderate PEM are referred from an outpatient department or an under-5 clinic, along with their mothers. A scheme for rehabilitation is outlined in Figure 22.

FIGURE 22. SCHEMATIC OUTLINE FOR REHABILITATION OF THE INFANT OR CHILD WITH PROTEIN-ENERGY MALNUTRITION (PEM).[51]




The basic aim of these units is to achieve nutritional rehabilitation for the children and, at the same time, to educate the parents, especially the mothers, in the feeding and care of children in an improved home environment. A specially trained auxiliary is likely to be in charge. She should be capable of giving health education talks to show how nutritious meals can be prepared from locally available supplies, how much the child should eat, and how often. Sometimes a mother actually prepares the food under supervision, but she always is expected to feed her own child. This is part of her training, and the task is to persuade her that similar meals can be prepared easily at home, at low cost, and at the same time as the "family pot." Primarily, she must be made aware that good meals are the only treatment her child needs.

If mothers of infants or young children who already have recovered through nutritional treatment only, can assist or participate in the talks and demonstrations, an excellent example is set for the mothers. Day centers that include a residence are the best settings for such a plan. The resident mothers can participate either at the centers or in the nearby outpatient facilities, for their teaching is often more effective and persuasive than that of nurses or other "white-coat" staff members. Fathers also should be encouraged to visit and join in activities at the residential center (Figure 23).

It is hoped that a mother who is discharged with her recovered child will go back to her village convinced of the value of the feeding pattern she adopted in the center and that her knowledge of improved feeding will be a good influence in her own community.

Sometimes it is useful to award such a mother a diploma for what she learned during the course of her child's rehabilitation and applied afterward at home. The diploma might have photographs of the child and mother on admission and again at discharge; such "before and after" evidence can be impressive.

Figure 23. Nutrition education in Ethiopia. A mother helps to teach at a demonstration center.

It is worth noting that the expense of running a nutrition rehabilitation unit is comparatively small; the cost per child per day is only a fraction of the cost for a patient in hospital.

## WHAT TO TEACH

### For the Infant

Traditionally and instinctively the majority of infants are fed breast milk on demand for the first few months of life. There are very few reasons why a baby should not be breast-fed and, in many circumstances, survival depends on it. Encouraging the continuation of breast-feeding for at least the first year of life is recommended strongly, particularly if the infant is liable to be weaned, as so often happens, onto a diet poor in protein value. Chapter 2 expands on this point.

Breast-feeding can be continued on demand when the mother works in the fields, at market, or even at some light industry in the local village community, but it is not as easy to do in the towns if the mother is working regular hours, especially if no day-care center is available. Under these circumstances, the infant probably will be left at home with an older sister or grandmother. Breast-feeding should be encouraged for the morning and evening meals but, while the mother is away, particular care must be taken to feed the infant suitable meals with adequate fluids, using clean, safe water.

At the age of about six months, the amount of available breast milk cannot by itself supply all the energy the growing infant needs. Chapter 3, "Weaning," details the food supplements that should be recommended; Chapters 5 and 6 describe the nutritional values of various foods; Chapter 12 explains double mixes and multimixes; Chapters 14 and 15 give examples of food mixtures. Selected materials from these and other chapters should be included in a teaching program.

*Hygiene*. We have stressed the importance of hygiene, and that food mixtures cooked into a pap or porridge and fed with a spoon from a clean cup or bowl are preferable to those given from a bottle, which is difficult to keep clean (Figure 24). Another dangerous, unhygienic method is feeding from the hand, which should be vigorously discouraged (Figure 25); it increases the bulk and reduces the energy concentration by dilution.

Another traditional way to prepare food for infants is for an adult to chew it first. The practice may help to give the baby a softer carbohydrate food. However, this small advantage must be weighed against the dangers of transmitting infections to the infant and underfeeding it.

Earlier, we mentioned that fats, oils, or sugar can add new flavors to a meal; they also reduce bulk. Examples of mixtures containing oil or sugar, suitable for infants, are given in the recipe section.

### For the Young Child

By tradition, the young child shares the adult family diet after breast-feeding ceases. By then he has teeth and is more than ready to chew food. The beneficial nutrient effects of adding vegetables or oil to a mix are shown in Table 10.

Figure 24. Feeding by cup and spoon.

Figure 25. Hand feeding should be discouraged.

Examples of vegetables that can be added to a mix and require the child to chew are also given.

TABLE 10. NUTRIENT EFFECTS OF OIL OR VEGETABLE ADDITIONS TO A BASIC MIX

| *Diet* | *Weight g* | *Energy kcal* | *Vit.A µg* | *Vit.C mg* | *Calcium mg* | *Iron mg* |
|---|---|---|---|---|---|---|
| *Basic mix* | | | | | | |
| 1. Rice | 65 ) | | | | | |
| | ) | 270 | — | — | 8 | 1.0 |
| Chicken | 30 ) | | | | | |
| 2. Rice-chicken mix plus | | 270 | — | — | 8 | 1.0 |
| Groundnut oil | 10 | 90 | — | — | — | — |
| Total | | 360 | — | — | 8 | 1.0 |
| 3. Rice-chicken mix plus | | 270 | — | — | 8 | 1.0 |
| Red palm oil | 10 | 90 | 200 | — | — | — |
| Total | | 360 | 200 | — | 8 | 1.0 |
| 4. Rice-chicken mix plus | | 270 | — | — | 8 | 1.0 |
| Butter | 10 | 75 | 72 | — | — | — |
| Total | | 345 | 72 | — | 8 | 1.0 |
| 5. Rice-chicken mix plus | | 270 | — | — | 8 | 1.0 |
| Groundnut oil | 10 | 90 | — | — | — | — |
| Tomato | 50 | 10 | 10 | 12 | 2 | 0.2 |
| Spinach | 20 | 10 | 60 | 20 | 50 | 0.8 |
| Total | | 380 | 70 | 32* | 60 | 2.0 |

* Cooking losses not accounted for.

The number of times he eats each day and his share of the family meal depends on when and how it is distributed in the home. Sometimes he eats from his own bowl or plate, but he may have to share a larger dish with other family members. In most places, the main part of the meal is provided by the staple food. This is accompanied by a side dish, such as a stew, sauce, or soup, which usually contains most of the meal's protein because its ingredients include meat,

fish, or beans. Therefore, it is important that the growing child gets a fair share, for a child's requirement for good protein per kilo body weight is higher than that of the parents. Unless special care is taken, the child's portion of fish or meat, eggs, or beans may be very small. In many societies, it is traditional for the father and the older male members of the family to eat first and take the best, usually the protein-rich parts of the meal; the women and children use what is left to flavor the bulkier staple food. A child between two and three years of age can be at a further disadvantage, because supplies of breast milk might have ceased, so intake of food depends entirely on what the mother thinks he should have.[52]

The number of meals available for a young child each day is a prime concern. If the adults in a household do not eat three meals a day, provision should be made for the child to eat frequently. He may be given snacks of food left from the previous meal and carefully stored, some fruit, a beancake, or some kind of drink that provides energy and protein. A guide to the adequacy of the food intake will be the child's record of regular weight gain and general alertness.

Between the ages of one and two, a child may not be able to manage the complete adult diet, and the simpler recommended recipes for mixtures or meals shown in the recipe chapter will be suitable in both energy and protein value, as well as in consistency and bulk. All these recipes contain ingredients that are available locally, are inexpensive, and likely to be used in most households as a family food. The preparation methods are traditional in the areas or regions in which the foods grow. At this age, young children often contract measles, whooping cough, or some other infectious disease. If their diet has been adequate, their symptoms usually are less severe than those of underfed children. However, even if sick, the child needs nourishment, and a troublesome cough or a sore mouth makes it necessary to alter the diet. Dry, crumbly foods or hot, spicy meals should be replaced with blander foods. Appetite, too, is affected by infection, and a sick child can be encouraged to eat by offering foods other than his usual intake.

# Chapter 9

# Measurements of Foods

In order to design food mixtures and calculate their nutritional value, weights for the ingredients must be known. If food is weighed, the correct amounts can be used each time a recipe is prepared. However, in most communities, household scales are rare, so weights of food must be converted into a measure of volume, such as cups or spoons. But, for measuring to be practical, the utensils or containers must be familiar locally, inexpensive, and easily available. The ideal utensil is one that is already in regular use in every household.

The amount of an ingredient in a recipe should be given simply in a whole unit that can be cut in half, if necessary. Fractions such as thirds or quarters should be avoided. It is not always easy to be accurate with household measures because shapes of utensils vary in breadth and depth. In addition, some ingredients pack easily on a spoon, others tend to spill off; food in a measure might be leveled with a knife, shaken level, or heaped to capacity. It is difficult to define a "rounded measure," so avoid this term.

A demonstration should show very clearly how to use the utensil for measuring. The same system should be used consistently for each measure: all spoonsful, for example, could be heaped and larger measures, such as a cup or a tin, could be shaken level.

In subsequent interviews with the mother, check whether correct measures are, in fact, being used. These checks may be oral, but it is better to ask the mother to show how she measures at home. Good measurements can convince the demonstrator that enough food is being cooked.

Foods vary in their weight for a given volume. Sugar, for example, is twice the weight of the same volume of most flours. Even the same food may vary in the weight of a particular measure. A cup of beans weighs more soon after harvest than the same cup filled some months later with beans from the household store or a market. If a storage container is full or nearly empty the quantity that can be heaped on a spoon might differ; a spoon is more difficult to "heap" from the bottom of a tin. More dried skimmed milk can be heaped on a spoon than sugar, which is easy to spill. The food might be slightly sticky, and so alter the measurement. Freshness and dryness of a food, such as bread, also will change the weight of the same measure. So while it may be difficult to measure out an exact weight, a close approximation is possible and practical. With practice, the housewife can develop a technique that is accurate to within a few grams of weight.

In most cases, instructions for measuring and preparing food should be oral and by demonstration. Any use of written instructions should be selective, as many intelligent women cannot read but can understand and remember readily.

In addition to the measurements described, weights can be related to the price of a market unit. If 5 cents always buys the same amount of some food, this price can be used to describe how much should be cooked. Weights also can be related to the size of a piece of food, such as a potato or tomato, a beancake, or an average-sized banana or plantain.

At the end of each demonstration, the quantity of the cooked food to be used at home, either at one meal or for the total intake throughout the day, should be made clear. The large quantities cooked at the center, so that everyone can have a taste, can be misleading for a mother and difficult for her to understand in relation to her child.

As a guide for demonstrations and to help the different health workers, weights of some commonly used foods are given in Tables 11 to 14. Various containers have been used as measures to show how tables can be constructed for local use. Blank columns have been left so that some local measures can be added to those listed. *But see Important Note on page 90.*

TABLE 11. BASIC MEASURES WITH EQUIVALENT WEIGHTS

*Abbreviations used:*

| | | | |
|---|---|---|---|
| 1 tspn | 1 teaspoon | 1 oz | 1 ounce |
| 1 Tbspn | 1 tablespoon | 1 lb | 1 pound |
| 1 g | 1 gram | 1 pt | 1 pint |
| 1 kg | 1 kilogram (1000g) | 1 qt | 1 quart |
| 1 l | 1 liter | | |
| 1 ml | 1 milliliter | | |
| A.P. | as purchased | | |
| E.P. | edible portion | | |

*Equivalent weights:*

| | | | | | |
|---|---|---|---|---|---|
| 30 g | = | 1 oz | 1 oz | = | 30g |
| 1 kg | = | 2.2 lbs | 1 lb | = | 450g |

*Liquid measures:*

| | | |
|---|---|---|
| 1 liter | 1000 | ml |
| 1 deciliter | 100 | ml |
| 1 centiliter | 10 | ml |
| 1 gallon (Imp.) | 4 | quarts = 8 pints = 4.5 liter |
| 1 pint | 600 | ml |
| 1 pint (Imp.) | 2½ | standard 8-oz measuring cups (20 oz) = 600 ml |
| 1 pint (U.S.) | 2 | standard cups = 480 ml (16oz) |
| 1 cup | 8 | oz liquid = 240 ml |
| 1 cup | 12 | tablespoons liquid |
| 1 cup | 16 | tablespoons dry |
| 1 tablespoon | 3 | teaspoons |
| 1 teaspoon | 5 | ml |
| 1 tablespoon | 15 | ml |

NOTE: Dry food can be measured or weighed. Small amounts of dry food may be measured with spoons, but larger amounts are more satisfactorily measured in a cup or its equivalent. All measures given in this table are level, using a standard-size, 8-oz measuring cup and standard-size measuring spoons.

TABLE 12. AVERAGE WEIGHTS OF SOME FOODS SHAKEN LEVEL IN A COFFEE CUP OR A BOX FOR WOODEN MATCHES

| | |
|---|---|
| Volume of coffee cup* | 85 ml |
| Volume of box for wooden matches | 25 ml |

| *Foods* | *Weight, g* | | |
|---|---|---|---|
| | *Coffee cup* | *Match box* | *For local measures* |
| Water | 85 | 25 | |
| Bean flour | 50 | 15 | |
| Cereal flours | | | |
| Maize,coarse | 60 | 15 | |
| Whole wheat | 60 | 15 | |
| Refined wheat | 50 | 10 | |
| Rice, long-grain | 70 | 20 | |
| Rolled oats | 30 | 10 | |
| Dried skimmed milk | 50 | 10 | |
| Sugar | 80 | 20 | |

*Coffee cup commonly used in Arabian countries and many others; it is called a Turkish, Arabic, or demitasse cup.

TABLE 13. AVERAGE WEIGHTS OF SOME FOODS
(in household spoons)

| *Foods* | *Approximate weight in grams* | | | | | |
|---|---|---|---|---|---|---|
| | *Level measures** | | | *Heaped measures* | | |
| | *Tea-spoon*** | *Dessert spoon* | *Table-spoon* | *Tea-spoon*** | *Dessert spoon* | *Table-spoon* |
| Water | 5 | 10 | 20 | + | + | + |
| Vegetable oil | 5 | 10 | 20 | + | + | + |
| Bean flour | 2 | 7 | 12 | 8 | 20 | 35 |
| Dried skimmed milk | 2 | 7 | 12 | 8 | 20 | 25 |
| Sugar | 4 | 10 | 20 | 8 | 25 | 40 |
| Refined cereal flour | 3 | 8 | 12 | 10 | 30 | 45 |
| Coarse cereal flour | + | 8 | 12 | 10 | 25 | 40 |
| Rice, long-grain | + | + | + | 10 | 25 | 40 |
| Rolled oats | + | + | + | + | 10 | 15 |

NOTE: + = Measure is not practicable or useful
* = Measures were leveled by removing excess food from the spoon with the blunt edge of a knife
** = Measures from 4 different teaspoons were used
Water: 1 Arabic coffee cup = 85 ml and is equivalent to 4 tablespoons, 8 dessert spoons, or 16 teaspoons

## TABLE 14. WEIGHTS AND EQUIVALENT VOLUMES OF SOME FOODS

The volumetric measures used:

a) Standard 8-oz measuring cup = 240ml
b) Cigarette tin = volume 240 ml
c) Milk tin = volume 200 ml
d) Standard measuring tablespoon = 15 ml
teaspoon = 5 ml
matchbox = 25 ml

| *Food + Descriptions* | *Weight in grams* | *Measure* | *For local use* | |
|---|---|---|---|---|
| | | | *Weight in grams* | *Measure* |
| Banana, E. P. average size | 90 | — | | |
| Butter, margarine, or lard | 30 | 2 Tbspns | | |
| Cassava flour, or gari | 180 | 1 cig. tin | | |
| Cereals, average whole-grain | 240 | 1 cig. tin | | |
| *Maize:* whole-kernel | 140 | 1 milk tin | | |
| flour | 155 | 1 cig. tin | | |
| starch | 140 | 1 cig. tin | | |
| *Oats:* meal | 165 | 1 cup | | |
| rolled oats | 90 | 1 milk tin | | |
| *Rice:* long-grain raw | 220 | 1 cig. tin | | |
| long-grain cooked | 250 | 1 cig. tin | | |
| flour | 200 | 1 cig. tin | | |
| *Sorghum:* flour | 150 | 1 cig. tin | | |
| *Wheat:* raw, parboiled | 130 | 1 milk tin | | |
| raw, semolina | 130 | 1 milk tin | | |
| refined flour | 150 | 1 cig. tin | | |
| whole-grain flour | 140 | 1 cig. tin | | |
| Coconut, desiccated | 90 | 1 cup | | |
| desiccated, immature grated | 8 | 1 matchbox | | |
| fresh | 70-90 | 1 cup | | |
| Dates, chopped | 210 | 1 cup | | |
| pitted only | 150-180 | 1 cup | | |
| Eggs, fresh, in shell | 60 | — | | |
| fresh, no shell | 50 | — | | |
| dried, no shell | 10 | 1 Tbspn | | |
| Fish, dry flakes | 2 | 1 Tbspn | | |
| fresh, flaked | 240 | 1 cup | | |
| dried anchovies (Ikan Bilis) | 26 | 1 milk tin | | |
| sardines | 100 | 8-10 fish | | |
| Groundnuts, no shells | approx. 120 | 1 milk tin | | |
| flour | 120 | 1 cup | | |
| roasted and ground to paste | 270 | 1 cup | | |

*more*

| *Food + Descriptions* | *Weight in grams* | *Measure* | *For local use* | |
|---|---|---|---|---|
| | | | *Weight in grams* | *Measure* |
| Legumes: lentils<br>pigeon peas<br>chick-peas<br>kidney beans<br>cow peas | 150 | 1 milk tin | | |
| soybeans | 130 | 1 milk tin | | |
| Lima bean, mung beans, haricot beans | 180 | 1 cup | | |
| Av. Legume flour | 90 | 1 milk tin | | |
| Meat, cooked, finely chopped | 240 | 1 cup | | |
| dried powder | 150 | 1 cup | | |
| Melon seeds, ground | 5 | 2 tspns | | |
| Milk: dried skimmed powder | 10 | 1 Tbspn | | |
| dried skimmed powder | 100 | 1 cup | | |
| whole milk powder | 130 | 1 cup | | |
| whole milk powder | 8 | 1 Tbspn | | |
| evap. milk, unsw. | 250 | 1 cup | | |
| condensed, sweet | 330 | 1 cup | | |
| fresh, cow's | 240 | 1 cup | | |
| Oil: vegetable | 15 | 1 Tbspn | | |
| red palm | 60 | ½ milk tin | | |
| red palm | 100 | ½ cig. tin | | |
| Onion, chopped raw | 160 | 1 cup | | |
| 1/2-kg chopped | | 3 cups | | |
| Plantain, E. P. | 180 | average of 10 | | |
| Sesame seed (beni-seed, sim-sim) | 20 | 1 Tbspn | | |
| Sugar: granulated | 15 | 1 Tbspn | | |
| granulated | 240 | 1 cig. Tin or 1 cup | | |
| brown | 180 | 1 cup | | |
| golden syrup | 360 | 1 cup | | |
| molasses | 360 | 1 cup | | |
| Yam flour | 135 | 1 milk tin | | |
| Spices | 5 | 1 Tbspn | | |

## Important Note

The weights of foods measured in *household* spoons and listed in Table 13 (page 87) show differences when *calculated* using values given for standard-size measuring spoons in Table 11. For example:

1 Tbsp. water *as measured* was 20g (Table 13) and *as calculated* 15g (Table 11).

Similar differences in weight or volume can be identified for different items reported in Tables 12, 13, 14 and 15b, where other types of measures and containers have been used.

These differences point up the fact that household spoons and other measures are not standard, but may vary in size, shape and volume. It is important that the weights and/or volumes of food recommended for feeding are adhered to.

Before the Manual is put to use for teaching purposes it is therefore essential to determine and record in the columns provided, the weights or volumes of the common local foods delivered by the spoons and other measures locally available and used in households in the area. A description of the measures/containers tested should also be recorded.

# Chapter 10

# Care of Foods and Utensils

In addition to measuring food, various utensils are used for its storage, preparation, and cooking, and for feeding the child. No matter what their use, they must be scrupulously clean in order to prevent contamination of the food and transfer of infections.

Household food must be stored in covered containers in a cool, shady place. The container may be tin, if it is suitably lined with a protective coating and free from rust, or it may be of aluminum, plastic, or unchipped enamel. A clean calabash or a scrubbed wooden container is sometimes satisfactory. Any container must have a lid so that excess air, all dust, flies, and vermin are excluded. These instructions are especially important for infant foods, which are rich sources of nutrients and make a perfect breeding ground for bacteria. High standards of cleanliness and hygiene are therefore necessary at all times to prevent food contamination.

Milks are often fed from bottles through feeding nipples. However, unless these utensils can be cleaned and sterilized and there are adequate supplies of new nipples for replacements whenever necessary, this method of feeding should be discouraged.

Utensils from which infants are fed must be free from sharp corners, imperfectly rolled edges and grooves or ridges, such as are found on screw lids or bottle caps. Any of these can hide dirt or food debris and so be a dangerous source of infection. Enamel, pottery, china, or glass can chip or crack; then they can seldom be cleaned properly, and so are not recommended.

Clean food in clean utensils needs boiled water and careful handling with clean hands. Thick plastic ware, well-finished aluminum, and heat-resistant glass are durable, easy to clean, and can be sterilized in boiling water. Before boiling, use a rough-surfaced or fibrous cleaning material or a brush to remove all traces of sticky food debris. If the cup has a spout, an infant can suck from it. A brush and simple cleaning materials, such as soap or detergent, if available locally, should be used along with the boiling water. In some communities, this standard of cleanliness is very difficult to achieve.

Boiled water is also an absolute necessity for mixing the food according to the instructions. In many communities, the safest method is to put the food in a cup and feed the infant immediately from a small spoon. If facilities allow, and if the mother has several bottles, nipples, and covers for them, she should put the prepared mixture into the bottle, attach the nipple and its cover, then immerse both bottle and nipple in boiling water for 15 minutes. True, it is not always easy

to judge the passing of 15 minutes, and some other way of estimating time might be suggested. The mixture should be cooled before being given to the infant. Once a feeding preparation is made, it should be used immediately; if too much milk has been prepared, the surplus should be given to another child or adult in the family or thrown away.

If utensils can be boiled only once a day, rinse and wash them thoroughly immediately after the infant has been fed. They should then be turned upside down on a clean, covered stand so they can drain and dry until they are next needed.

If fuel and water are scarce, cups and spoons or bottles and nipples can be sterilized in another way. However, because it requires a chemical sterilizing solution, it is expensive, and the manufacturer's instructions must be followed exactly, otherwise the solution will be ineffective. Utensils are rinsed, washed, drained, and put in a large container which has been kept covered for protection from dust and flies. The chemical solution is mixed with enough water to cover the utensils completely. The utensils remain in this solution until time for the next feeding. Before they are used, they must be rinsed thoroughly with clean water to remove all traces of the chemical. After two days, the chemical will no longer sterilize satisfactorily and the solution must be changed. This method should be suggested only if it is certain that the mother can use it properly.

However, the best and safest way to sterilize utensils is to wash them and boil them in a large pot. If several cups and spoons are available, they can all be done at one time. If the pot has a lid to retain the steam, the water need not cover the utensils completely. The boiling may be done on the same fire that is cooking a meal. After boiling for a suitable length of time, the pot should be removed from the fire. The utensils should be left in the covered pot to cool until they are next needed. Sterilizing done in this way once a day makes more economical use of both water and fuel.

These cautions make it clear that, for artificial feeding to be safe, a great deal of care and time must go into the preparation. It also is more expensive in materials, time, and fuel than is breast-feeding. However, if artificial feeding is necessary, it is essential that the mother learn how to prepare the food, using the cheapest full-cream or half-cream milk that is available locally, and that she uses the same method for each feeding.

## WATER AND FUEL SUPPLIES

To have safe food, there must be adequate amounts of water and fuel. Water supplies are not always ideal. Sometimes it must be carried some distance and, understandably, supplies are kept standing in the household for hours at a time and rationed carefully. For this reason, and because the original source of the water many not be safe, it is important that any water given to infants must first be boiled and then covered until it cools. The main water container itself must be clean and free from debris. To boil water requires fuel. In many households,

this is an important consideration because of the availability and cost of fuel, in terms of money or the time taken to collect it.

Fuel supplies are of many kinds: twigs or tree bark, animal dung, refuse from crushed oilseeds or milled cereals, coal or charcoal, kerosene or paraffin, gas or electricity. Fuel may be used in open fires at ground level, in Primus stoves, or in sophisticated modern kitchen equipment, but the amount available determines the number of times each day that food can be cooked or water boiled. Advice given in any community for cleaning utensils, for the provision of clean, boiled water, and for the preparation of infant foods must be related to existing practicalities.

Unfortunately, in areas where fuel and water are in short supply, gastrointestinal infections are common. The infant's only chance for survival in these circumstances depends on a good supply of breast milk and such supplies of supplementary food as can be prepared and fed easily.

# Chapter 11

# Formula Feeding

Because it is not always possible to provide breast milk for an infant, replacements or substitutes must be found. Most of these are based on one of the many varieties of commercially prepared milk formulas. In poorer communities, attempts at artificial feeding lead to many problems, some of which are actually dangerous for the infant. However, it is safe to say that with reasonable economic and hygienic standards, and if the manufacturer's instructions have been carefully followed, an artificial milk formula that provides for all the infant's requirements does not seem to result in any disadvantage in normal growth and development. A certain percentage of mothers in developing countries can safely manage to feed their infants artificially after the first few weeks, if necessary. Nevertheless this "Western-style" trend should not be encouraged, as there is evidence to show that satisfactory growth and development after birth is more certain when an infant is fed adequate amounts of breast milk.[53,54]

Artificial foods make greater demands on the infant's digestive system and kidneys than does human milk, and these demands are increased if the foods are prepared carelessly or incorrectly because instructions are misread, misinterpreted, or misunderstood. A great number of commercial milk formulas are available for the infant who, for one reason or another, cannot have breast milk. These formulas vary in cost and in kind, from a simple preparation of fresh liquid milk to a complex artificial formula, but any substitute milk requires great care in preparation, even after the recommended instructions have been read and understood thoroughly. The substitutes fall into certain groups, some of which require the basic preparation plus additions, and others, termed "complete" foods, need only to be reconstituted into the liquid formula.

## UNMODIFIED MILKS

These are the simplest substitutes. Most often they consist of whole cow's milk in one of three forms: the milk itself; the dried, full-cream powder; or the liquid concentrated commercially by evaporation (see also Chapters 6, 9, and 10).

### Whole Liquid Milk

This must first be boiled, then diluted with clean, boiled water to reduce the protein and salt content. Sugar is added to increase the energy value of the less-

concentrated milk. Boiling the milk is necessary both for hygienic reasons and to alter the cow's milk protein so that the curd formed in the infant's stomach will be of a softer consistency and easier to digest. Usually one part of water is added to two parts of milk, with a stated amount of sugar per feed.

### Full-cream Milk Powder

Alterations to the protein are completed during manufacture. For preparation, therefore, only the addition of boiled water and sugar is necessary to reconstitute the powder to the same dilution as that based on the fresh milk product. Usually one part by weight of powder is used with 10 parts of water. By volume, one part milk powder requires five parts of water.

### Evaporated Milks

These are full-cream milks that have been concentrated by evaporating the water under vacuum. Often they have been fortified with vitamins A, D, and C and sometimes with iron. These milks require dilution only, and one part is used with two or two and one-half parts of water, depending on the brand. Sugar also must be added to adjust the energy value.

These products and the full-cream powder store well until the can is opened, but, in a hot climate, the fat is liable to go rancid and the contents become contaminated unless strict hygienic standards are observed. Some instructions for simple milk mixtures are given in Tables 15a and 15b. They have been designed to meet the infant's average requirements in the volume recommended per kilo body weight.

In addition to energy and protein value, the total volume of food given per day is an essential consideration. Volume is related to the baby's weight, and food usually is given five times daily at four-hour intervals. After the infant is three or four months old, undiluted cow's milk can be given, but it should still be boiled first.

### Condensed Milks

These are entirely different products from evaporated milks, and should not be used for infant feeding except in an extreme emergency. They have a full-cream or skimmed-milk base and, if the latter, contain no fat-soluble vitamins.

All contain sugar, about 45 percent by weight, and thus have a high carbohydrate content and a very sweet taste, but a comparatively low proportion of protein. If no other milks are procurable for an infant, a mixture can be given, on a short-term basis, using one part of condensed milk to seven parts of clean, boiled water.

## TABLE 15 a: PREPARATIONS FOR FEEDING INFANTS UP TO 3 MONTHS OF AGE

Approximate daily volume[a]: 150 ml / kilo body weight
2½ oz / lb body weight

Infant's average weight: 4.6 kg

All measures are LEVEL[b]

| *Type of milk* | *Cow's milk, boiled* | *Full-cream milk powder* | *Evaporated milk* | *Dried skimmed milk*[c] |
|---|---|---|---|---|
| *Dilution* | | | | |
| Milk | 2 parts<br>100 ml—½ cup | 14g—1½ Tbspn | 50ml—2 Tbspn | 10g—1 Tbspn |
| Water, boiled | 1 part<br>50 ml—¼ cup | 150 ml—¾ cup | 100ml-½ cup | 150ml—¾ cup |
| *Add* | | | | |
| Sugar | 10 g—2 tspn | 10 g—2 tspn | 10 g—2 tspns | 10g—2 tspn |
| Oil | — | — | — | 2g—1 tspn |
| *Per 100 ml of feed* | | | | |
| kcal | 70 | 75 | 75 | 75 |
| protein, g | 2.2 | 2.4 | 2.3 | 2.4 |

Energy requirements / day = 550 kcals
Protein requirements (score 100) = 2.4g / kg
If score is 80 (cow's milk) = 14g / day

(a) Feedings, as shown, should be given at four-hour intervals, five times daily.

(b) See Chapter 9

(c) In emergency only:

Dried skimmed milk is considered unfit for babies. It contains no fat and has a reduced energy value. Most brands are not fortified with vitamins A, D, or C, and the oil necessary to adjust the energy value along with the sugar is unlikely to have any vitamin value. Therefore, this form of food should be used only as an emergency on a short-term basis, and must be supplemented with the vitamins it lacks. (See also Table 10)

## TABLE 15b: PREPARATIONS FOR FEEDING INFANTS 3 TO 5 MONTHS OF AGE

Approximate daily volume[a]: 150 ml / kilo body weight
2½ oz / lb body weight

Average infant's weight: 6.7 kg

All measures are LEVEL[b]

| *Type of milk* | *Cow's milk, boiled* | *Full-cream milk powder* | *Evaporated milk* | *Dried skimmed milk*[c] |
|---|---|---|---|---|
| *Dilution* | | | | |
| Milk | 175ml | 25g - 3 Tbspn | 80g - 3 Tbspn | 20g - 2 Tbspn |
| Water, boiled | 1 - 2 Tbspn | 200ml > ¾ cup | 120ml > ½ cup | 200ml - ¾ cup |
| *Add* | | | | |
| Sugar | 10g - 2 tspn | 10g - 2 tspn | 16g - 2 tspn | 10g - 2 tspn |
| Oil | — | — | — | 5g - 1 tspn |
| *Per 100ml of feed* | | | | |
| kcal | 105 | 110 | 100 | 105 |
| protein, g | 3.5 | 4.3 | 3.7 | 4.8 |

Energy requirements / day = 770 kcal
Protein requirement (score 100) = 1.85g / kg
If score is 80 (cow's milk) = 15.5g / day

Note with Table 15a also applies to this Table, especially note (c).

### Skimmed-milk Powder

This product also is unsuitable for infant feeding, except in an emergency and when vitamin supplements can be added (Table 15a, note c). Very few brands of this powder are fortified with vitamins A and D. No instructions are given on the package or tin to indicate the required amount to be used or the amount of sugar that should be added for each feeding. In fact, the tins usually are labeled "unsuitable for infant feeding." As a liquid, perhaps for older children, the powder can be reconstituted and one part by weight to 10 parts of water or one part by volume to five parts of water. However, if freeze-dried granules are used, one part by volume of the larger granules should be used with 3.5 parts of water (see also Chapter 6).

## MODIFIED MILKS

These are almost always in powdered form and are based on either full-cream, three-quarter cream, or half cream cow's milk. Those with less cream are intended for infants in the first months of life. The powder is reconstituted with boiled water, usually one part by volume of powder to seven parts of water, although sometimes less water might be recommended by the manufacturer. Some powders need an addition of a specified amount of sugar. Others, labeled "complete" foods, contain lactose sugar, rather than cane sugar.

Most of these modified milk powders have been fortified with vitamins A, D, and C, and with iron. The protein in some brands also has been modified by additions of soluble whey proteins to replace some of the more insoluble casein. The fat content may also have been adjusted to correspond to the concentration in human milk.

## "HUMANIZED" MILKS

These artificial formulas are based on cow's milk, but are specially designed to resemble the composition of human milk as closely as possible. The modifications have altered the kind of protein and the fat. In most cases, the fat has been replaced with vegetable oil, which has some properties similar to breast-milk fat. The carbohydrate has been adjusted with lactose, and a number of changes have been made in the other nutrient constituents, including calcium and phosphorus, sodium and potassium, iron, and some of the trace elements, such as zinc. The formula has been fortified with fat-soluble vitamins, vitamin C, and many of the B-complex group, including vitamin $B_{12}$ and folate. Because they are "complete" foods, these powders require only reconstitution to a liquid form—usually one part by volume to seven parts of boiled water—although there are minor variations among brands. No doubt because of the complexity of their manufacture, these products are usually more expensive.[54]

Whether unmodified, modified, or "humanized," it is essential for the infant's well-being that these powders be prepared in strict accordance with the

maker's instructions. If measuring scoops are provided, they must be used exactly as directed. Similarly, the boiling water must be measured accurately, either by a stated amount added to the powder, or by the measuring jug, feeding cup, or bottle being filled up to a specific level or mark.

## OTHER INFANT FOODS

Mention should be made here of other specially prepared foods. These are not milks, but a wide variety of canned foods prepared for infants and young children and commonly used in the industrialized countries. They are meat broths and meals, purées of fruits or vegetables, and puddings of milk, cereal, and sugar. The canned food has the advantage of being sterile until opened and of being in an amount and consistency that a child might be expected to eat at one meal. The contents of the can are indicated on the label, as is the age for which it is suitable.

However, though very convenient, they are relatively expensive when compared to conventional food costs. Because of the cereal and/or sugar in many of the products, the carbohydrate content is often higher than desirable. Labels can be deceptive, and the amount of meat, for example, in a mixture with vegetables might be minimal. More salt might be added to savory mixtures than is necessary or suitable for infants. Some foods, called "mixed baby cereals," should have milk or broth added and require no cooking, but such mixtures can be dangerous, if the water is not safe. These solid foods need not be introduced into the infant's diet too early in life if milk supplies are adequate, and should not be encouraged. Even though the foods may be tolerated, there is no evidence to show that in early life they benefit growth and development; the practice could even be harmful.

## OTHER POWDERS

These contain a number of ingredients, but milk is not necessarily predominant. They are chocolate-flavored and may or may not be malted. Many are sweetened with sugar. They are intended to be reconstituted with milk, perhaps partially diluted with water to make a flavored drink for children. Unfortunately, they use no milk, and so supply only flavor and energy, with minimal protein value.

For those mothers who have satisfactory hygienic and economic standards in their households and who are able to read written instructions, a diagramatic plan of how an infant might be fed artificially is given in Figure 28. And the plan is described fully in Chapter 14. All of the milk formulas and other foods which have been discussed are imported in most tropical countries, which adds to their expense.

## PROBLEMS WITH FORMULA FEEDING

The preparations that have been discussed can be used successfully as substitutes for breast milk, or even to supplement inadequate amounts of it, but

they can be a source of danger in many rural and poor urban homes for a variety of reasons.

The availability of such a wide range of milk formulas and other infant foods presents a confusing picture both to the mothers and to those who should advise them. There is little difference among the full-cream milk formulas, except perhaps in the modification of the kind and amount of protein. If essential, the "complete" foods which require only reconstitution, are to be preferred. The "humanized" milks are more costly than the others.

Many factors influence the mother's choice of a product. Sometimes it is cost, but the cheapest brand will not always be selected, because another might have higher status value. At other times, the most popular choice is the brand most readily available, or the decision might depend on the best sales promotion or the brand in the most useful container.

However, no matter which brand is chosen, there are still problems in the use of artificial milks. Even in countries where the literacy rate is high, the instructions given for preparation of the foods seem difficult to follow with any degree of accuracy for a number of reasons:

*Labels:* So much is printed on the outside of the package that it is difficult to separate precise instructions from general information. The confusion is increased if the print that is superimposed on a picture or a seam on the tin is particularly small, or is printed sideways and cannot be read once the can has been opened.

*Pictures:* They can be indistinct and do not always illustrate the written instructions exactly.

*Measuring scoops:* Those provided can be awkward to use, and their shape makes it almost impossible to comply with instructions which call for half-measures. If the scoops are small and a number of scoopsful must be measured, it is very difficult to keep a correct count, if there are any distractions. As the package empties, accurate measurements become even more difficult.

*Measurements:* Instructions vary. Some powders are added in scoops only for the required amount. Others are to be shaken level on a measure; the measure is to be filled and lightly leveled with a knife; or it is first packed tightly and then leveled.

Requirements for use of boiled water also vary, as mentioned before. Complications can arise if, for some reason, a different brand is purchased and no check is made on the new instructions.

*Utensils:* Correct preparation also depends on the availability of suitable utensils. If they are not at hand, controlling the concentration of the feeds is even more difficult.

*Other instructions:* The amount of powder, or the number of scoops to be used, is related in the instructions to age (expressed in weeks or months) or

to body weight measurements (expressed in Metric or British system). If the print is very small, an error can be made easily. Some manufacturers suggest offering the infant more than the required amount at each feeding. It could be hard for some mothers to decide what is meant by "more."

Even persons used to measuring and weighing can make mistakes. Test demonstrations have shown that the concentrations of similarly prepared feedings show significant differences. According to one series of measurements, sample feedings for infants with daily needs of 550 kcal and 11g protein can vary by as much as 200 kcal and 7g protein during a day.[55] Artificial formulas that provide energy and protein in addition to basic needs can create problems for the infant, particularly if other supplementary foods are given at the same time. More breakdown products, particularly from proteins, are found when this method of feeding is used, and more water must be provided to permit excretion of those products through the kidneys. It is essential to provide enough safe water with artificial formula feeding, particularly in hot climates, where perspiration causes considerable water loss. Babies are usually tolerant and do manage to thrive on a formula regimen, but when they cry, it is not always for food. Often it is for a drink. If the mother gives more food instead, the results could be damaging to the infant.

In spite of these difficulties, artifical feeding seems to be adequate if done properly. However, in many rural and poor urban communities, where literacy rates are likely to be low and the environment is unsatisfactory, other problems arise that make this feeding method dangerous. These all have been discussed, but are worth stressing again:

A proper selection of suitable utensils may not be available in the household.

The ability to keep either the milk substitute or the utensils clean, let alone sterilized, is sometimes impossible.

Satisfactory storage facilities for the milk powder are hard to arrange.

The maker's instructions, or even the diagramatic illustrations, are not read or fully understood because the print is too small, too indistinct, or in a foreign language. In many cases, the mother cannot read at all.

Even if weight and age of the infant are known, a mother may be uncertain about the correct quantities of food to be given.

Because of expense or availability of supplies, a tin of powder must last a specific time. As a result, mothers often add extra water to extend the powder. This is the most common and serious mistake. Availability of supplies may also be erratic, due either to distribution problems or to the lack of money.

Contaminated water is an additional danger if water and or fuel are in short supply.

## THE COST OF FORMULA FEEDING

The difficulties that low-income families might have in providing enough milk formula to replace breast milk was mentioned in Chapter 3, where problems associated with weaning are discussed. The cost of bottle-feeding an infant is not feasible for many families. If this method is used, nutritional needs may not be met because not enough milk formula can be bought regularly. The money earned in some occupations is insufficient, and often money earned by subsistence-farming families cannot meet the food costs for the youngest family member.

In a European country, an infant can be fed adequately because only a small percentage of the family income is used for that purpose. The differences between European countries and developing nations can be seen in Table 16, where the costs of adequate formula-feeding are expressed as a percentage of incomes for specific occupations in several countries.

TABLE 16. COST OF COMPLETE MILK-FORMULA FEEDING EXPRESSED AS PERCENTAGE OF MONTHLY SALARIES FOR SELECTED OCCUPATIONS IN DIFFERENT COUNTRIES

| | *Hospital cleaner/orderly* | | *Ministry clerk* | | *Junior staff nurse* | |
|---|---|---|---|---|---|---|
| *Age of infant in months* | *0-2* | *3-5* | *0-2* | *2-5* | *0-2* | *3-5* |
| | % | % | % | % | % | % |
| Bahrein | 13 | 19 | 8 | 12 | 7 | 10 |
| Egypt | 28 | 39 | 18 | 26 | 14 | 19 |
| Ethiopia | 55 | 77 | 15 | 21 | 7 | 10 |
| Liberia | 20 | 29 | 7 | 10 | 6 | 9 |
| Malawi | 66 | 93 | 57 | 80 | 10 | 14 |
| Malaysia | 26 | 36 | 14 | 19 | 5 | 7 |
| Pakistan | 18 | 25 | 12 | 16 | 8 | 11 |
| Sudan | 42 | 50 | 31 | 38 | 31 | 38 |
| *Sweden | 3 | 2 | 3 | 2 | 3 | 2 |
| Tanzania | 29 | 41 | 25 | 35 | 19 | 28 |
| United Kingdom (London) | 3 | 4 | 4 | 5 | 2 | 3 |

*Humanized milk is used for 0-2 months only. This is more expensive than the formula for 3-5 months. (Information for this Table was obtained from pediatricians, nutritionists, and home economists of, or working in, the countries concerned in 1975. Salaries are at the basic rate in each country. The formula costed was a popular brand. Daily energy requirements were based on information given in Table 6: for 0-2 months: 550 kcal; for 3-5 months: 770 kcal.)

# Chapter 12

# Supplementary Feeding

## LOW-COST LOCAL WEANING MIXTURES

After the age of 6 months, breast milk cannot supply all the infant's needs for energy, protein, and other nutrients. Then the milk supply must be supplemented with other suitable foods. The advantages and disadvantages of some Western-style commercial preparations for infants have been discussed, but their cost limits their use in tropical countries to the small percentage of households that can afford them. To relieve this problem, many countries are trying to produce supplementary foods which are cheap and easily distributed in their own markets for use in the weaning and pre-school periods. To be successful, these foods must be introduced to mothers who then must be taught how to use them safely and effectively. It is not always easy to persuade people to use food with a new flavor, a different appearance and texture, and one that is not a familiar household commodity.

The ingredients usually are processed plant foods that are available locally, although some contain a certain amount of dried skimmed milk and are mixed to give the best protein value. Minerals, often calcium and iron, and vitamins are added. Some of the mixtures can be used on their own as substitutes for milk, but they usually are more valuable when added to other weaning foods. These mixtures are relatively inexpensive to produce, but they often must be subsidized in order to sell at a price which can be afforded by the low-income groups. In a country with a limited budget, this is not always economically feasible.

Three different types of low-cost commercial mixtures are manufactured:

1. Based on a staple cereal, with the addition of a vegetable protein concentrate, e.g., cottonseed flour. An example is Incaparina, developed in Guatemala in Central America. It contains no animal protein.

2. Based on wheat and a high percentage of precooked peas and lentils, which provide most of the protein. One is Superamine, produced in Algeria. This mixture also contains 10 percent skimmed-milk powder.

3. Based on a mixture of cereal (wheat) and a legume (chick-peas) with the addition of a vegetable-protein concentrate (soy flour) and 5 percent dried skimmed milk. Faffa, made in Ethiopia, is an example.

Vitamins and minerals are added to most such products. All have more than 20 percent protein (Incaparina has 25 percent), but, because the energy value is usually low in relation to protein concentration, some sugar and/or fat must be added when the product is prepared for use.

## WEANING FOODS PREPARED AT HOME

Suitable mixtures for feeding during the weaning period can be made in the home by using foods from the household garden or the market. Because this is possible, health personnel should realize the importance of having a good, practical knowledge of all the local foods and their nutritive value. Unless there is a disaster, such as flood, drought, or hurricane, supplies should be readily available according to the season, and are likely to be inexpensive. These foods already are ingredients in the "family pot," so the mother is familiar with them; she knows their flavors and how to prepare them, and she has all the necessary cooking utensils.

The main food of the household is often cooked or pounded into a thick porridge as an important part of the family meal. Some of the same porridge can be used for the six-month-old infant or a young child if it is thinned slightly and given by spoon from a cup or bowl. Preferably, it should be made from a local cereal, rather than a starchy root or fruit, and it should be supplemented with one of the ingredients in the family's side dish—soup, sauce, or stew. The supplement might be a small amount of lean meat, fish, eggs, milk or a milk product, such as curds, or some well-cooked beans or dhal. As the infant grows, small amounts of suitable vegetables can be added as well to help improve the protein and other nutrient values of the basic porridge.

### Double Mixes

Double mixes are the simplest. They contain only two main foods, the staple and one other. If the mother is taught which second food to use with her staple and how much of it, she can prepare these mixes easily when she is cooking her family's meal. The basis of a demonstration at the clinic, or even in the home, can be teaching the best proportions of foods to use.

Staple foods vary in their over-all nutrient values, so different amounts of supplementary foods are needed to adjust their protein value for infants and young children. Bulk can be reduced by using some butter, oil, ghee, and/or sugar. To make allowance for these concentrated but empty calories, a larger proportion of supplementary food must complete the mix.

In practice, then, it becomes necessary to adjust the ingredients used to reduce the bulk, or volume, of a double mix so that the amount given to the infant or young child satisfies needs for energy and nutrients and is suitable for the stomach's capacity.

The adjusted amounts of ingredients are shown in Table 17a.

The weights of the ingredients have been selected to fulfill the following conditions:

(1) each mix provides about 350 kcal;

(2) each has a protein value adequate for young children;

(3) the bulk of each has been reduced to a minimum in order to suit the stomach capacity.

It is difficult to apply all these conditions to mixtures of a staple and a legume because, no matter how carefully it is prepared, too much legume is difficult for an infant to digest. In practice, it has been shown that a double mix with beans should begin with one part beans to four parts staple, preferably a cereal. The amount can be increased gradually until one part beans can be used with two parts staple. Table 17b has been included as a useful guide for planning mixes based on a staple and a legume, and fulfills most of the conditions in Table 17a.

The amount of supplement is the minimum quantity necessary to make an economical mix containing a satisfactory protein value for those in the communities for which it is intended. If more of the supplements are available, additional amounts can certainly be used, although it may increase the bulk.

Of the suggested quantities, each mix, with its stated amount of fat or sugar as concentrated energy, provides about 350 kcal with a protein value suitable for infants and young children. This amount can constitute a main meal of the day for a child about one year old to supplement the breast milk being taken at that time.

The same amount of mix is sufficient for a whole day for a younger infant. It should be divided into protions given at least three different times during the day. If this is done, great care must be taken in handling and storing the food, which undoubtedly would be prepared and cooked at one time to save fuel and time.

To each mix of ingredients shown in Tables 17a and 17b should be added:

10 grams butter, ghee, or oil
or
20 grams sugar
or
5 grams butter or oil *plus* 10 grams sugar

TABLE 17a. DOUBLE MIXES
Adjusted for Least Bulk

With the oil/sugar used as stated, each mix provides about 350kcal*

| SUPPLEMENT g / STAPLE g | *Oats* | *Wheat* | *Rice* | *Millet / Sorghum* | *Maize* | *Potato* | *Sweet Potato* | *Yam* | *Taro / Cocoyam* | *Banana* | *Plantain* | *Cassava Flour (Gari)* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Egg | 65<br>10 | 65<br>25 | 65<br>30 | 60<br>30 | 65<br>25 | 300<br>25 | 180<br>35 | 220<br>25 | 190<br>25 | 190<br>30 | 150<br>45 | 60<br>50 |
| Dried skimmed milk | 65<br>5 | 65<br>10 | 65<br>15 | 60<br>15 | 60<br>15 | 280<br>15 | 175<br>20 | 190<br>15 | 180<br>15 | 165<br>20 | 150<br>20 | 60<br>20 |
| Dried whole milk | 55<br>10 | 55<br>15 | 45<br>25 | 45<br>20 | 40<br>25 | 220<br>20 | 100<br>30 | 115<br>30 | 115<br>25 | 100<br>30 | 90<br>30 | 35<br>30 |
| Fresh fish | 65<br>15 | 70<br>30 | 70<br>30 | 70<br>25 | 70<br>20 | 310<br>25 | 210<br>35 | 240<br>35 | 220<br>40 | 210<br>40 | 180<br>45 | 75<br>50 |
| Chicken or lean meat | 65<br>10 | 65<br>20 | 65<br>25 | 65<br>25 | 65<br>35 | 300<br>25 | 180<br>35 | 210<br>35 | 195<br>30 | 185<br>40 | 160<br>45 | 70<br>45 |
| Soybean | 60<br>10 | 60<br>15 | 55<br>20 | 55<br>15 | 50<br>25 | 250<br>20 | 150<br>25 | 175<br>20 | 150<br>20 | 140<br>25 | 115<br>30 | 50<br>30 |

NOTE: *a) To each staple-supplement mix add: 10g oil **or** 5g oil + 10g sugar **or** 20g sugar.

b) Each mix has the same protein value, which is suitable for young children (net dietary protein provides about 6 percent of total energy).

c) It is possible to adjust the staple-supplement proportions slightly, but if more of the staple is used, the bulk is greater.

d) The top number in each box refers to the staple; the bottom number to the supplement.

## TABLE 17b. DOUBLE MIXES WITH LEGUMES

Because too much legume in a mix is difficult for the young child to digest, the following staple/supplement proportions have been selected. Each mix has the same protein value as those in Table 17a and provides 350 kcal, if the oil/sugar is used in the quantities stated below.

| | *Oats* | *Wheat* | *Rice* | *Millet / Sorghum* | *Maize* | *Potato* | *Sweet potato* | *Yam* | *Taro / Cocoyam* | *Banana* | *Plantain* | *Cassava flour* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STAPLE g | 75 | 80 | 65 | 75 | 55 | 320 | 125 | 165 | 150 | 105 | 85 | 40 |
| LEGUME g | 5 | 10 | 25 | 10 | 35 | 20 | 50 | 40 | 45 | 55 | 55 | 55 |

NOTE: a) To each mix add 5g oil **or** 10g sugar.
b) Suitable mixes are impractical with cassava flour.

For example:

(1) To 70g rice, into which 30g of fresh fish or 10g of dried fish is beaten, add 10g of oil, butter, or ghee.

(2) To 65g wheat flour or semolina and 10g dried skimmed milk, add 20g sugar or 10g sugar with 5g of butter.

It must be remembered that cereals absorb water when cooked, so their volumes might increase two or three times. Fresh tubers, plantain, and starchy roots absorb very little moisture, so their bulk remains relatively unchanged after they have been boiled or steamed.

Reminder: If too much oil or sugar is used constantly, more energy will be provided than is required. That is, if all of such a mixture is eaten regularly, it will be in excess of the needs of a relatively inactive child who could, as a result of that intake, become obese. If the mixture is too concentrated, and the child's appetite is satisfied before all the food is eaten, some of the protein and other nutrients will be wasted in the unfinished portion. The regular intake of food that provides adequate energy without a reasonable proportion of all other nutrients leads to reduced nutritional status and malnutrition.

## Multimixes

In many homes, foods from animal sources, or their products, are not available except on special occasions, and then only in small amounts for the youngest family members. If obtainable, these foods can be used with beans in any mixture, and they reduce the quantity of beans needed to give the same protein value to the meal. Multimixes consist of three main ingredients: the staple food, beans, and whatever animal product is available. For example, some milk or finely flaked fish might be added to a porridge of rice and beans.

Small amounts of dark-green leaves, tomatoes, pumpkin, or other vegetables can be added to complete these multimixes. Alternatively, mango, pawpaw, or other fruit in season might be given after the meal. The value of such additions was shown in Table 10.

The following information will make Tables 17a and 17b more useful. (All weights are given in edible portions of food.)

*Dried skimmed milk (DSM):* This is best used beaten into a hot, cooked mix. If the powder is reconstituted before being cooked, the maker's instructions suggest using 100g to make 1 liter, or 2 ounces to make a pint.

*Dried whole milk (DWM):* If fresh milk is available, use eight times more than for the powder. For example, 10g DWM is equivalent to 80 ml (or grams) of fresh milk. The equivalent amount of curds or soft cheese also can be used.

*Egg:* Weights are given because eggs vary in size. One average egg without shell weighs 50g; 15g dried egg is equivalent to 50g fresh egg.

*Chicken or lean meat:* 10g chicken or well-cooked lean meat, suitably shredded, minced, or chopped.

*Fish:* The weight for a fresh fish is in Table 17a. If dried fish, such as salt cod or stockfish is used, only one-third of the given quantity is required.

*Soybean:* 10g of soybean is equivalent to approximately 60g of soybean curd. Smaller amounts are needed for drier pastes or cheeses.

*Legumes* (average type): These should be well cooked without skin and mashed finely. Whenever possible, add one of the other supplements to the beans. If groundnuts are used, include more of another supplementary food. Sometimes an oilseed, such as sesame seed, is used. For more information, see the recipe section.

*Cassava:* If fresh cassava root replaces the flour or gari, multiply the quantity given in Tables 17a and 17b by two.

Two general suggestions for cooking: During cooking, cereals absorb two to three times their weight in water. If fresh whole milk is available, it can replace water, in which case no other food supplement is needed.

# Chapter 13

# Planning an Infant Feeding Program

It has been mentioned that an enormous public health problem exists because so many infants and preschool children suffer from poor nutrition or undernutrition. Deaths of vast numbers of children throughout the world are caused, either directly or indirectly, by starvation. Others suffer permanent physical defects or mental retardation. For these reasons, health personnel at all levels must know practical ways to prevent malnutrition, as well as methods for treating it. A program designed to prevent malnutrition must claim the active interest of all those who will use it.

If a program is it to be started in a new area, a great deal of information must first be collected. Some of the information needs are described below.

## FIND OUT ABOUT THE PEOPLE

The first step is to get to know and understand how the people in the area live and, at the same time, to gain their confidence and respect. The community worker should become familiar with their traditional leaders, their pattern of authority, their social customs and cultural beliefs, the work they do, and their level of education. The worker also should try to discover what the people think are their most urgent priorities or needs.

Because of difficulties with dialects, an interpreter may be needed, but all personnel should learn some few words of greeting and common courtesies before any interviews begin. The interpreter must be a person who is acceptable to the community and its culture.

Information on the most relevant health problems is essential. This will give a clear idea of specific nutritional deficiencies and the commonest infections or parasite infestations in the community. Any attempts to make changes must be built around the best of the traditional customs.

## FIND OUT ABOUT FOOD

Every community has its traditional feeding patterns and beliefs about certain foods, which are favored and prestigious; some others are taboo. Usually, some reasoning lies behind these beliefs, and that should be ascer-

tained. In addition to knowing what foods are used, information must be collected on the available kitchen utensils, storage methods, water sources, fuel and any difficulties in obtaining it, cooking methods, and meal distribution within the family.

Apart from observing what goes on in the households while endeavoring to know the people, a great deal can be learned from looking at the village gardens, the fruit trees, bushes or vines, and by frequent visits to the local market to see what items are stocked and what is bought, their unit costs, and the usual amounts purchased. Discussions with the people will help a worker to discover some of these facts and, at the same time, will establish a sympathetic contact between the worker and the new community (Figure 26).

Prestige foods are not always the most nutritious, but they may be made more valuable nutritionally and still keep their status by small modifications or additions. The means by which this can best be achieved depend on careful observation.

## FIND OUT ABOUT FAMILY ECONOMY

Proposals for improving the infant's intake of food can be made only after establishing where the food comes from. Advice depends on whether the household is dependent on a subsistence economy, in which the food is grown at home, or whether it is all bought at a market. The quantities of food available or how much money is spent on it also must be known. In either case, expenditure is affected by market prices, which to a great extent influence the quantity of available food for any family. Giving advice on the budgeting of home-grown food supplies from one harvest to the next is more essential in the rural areas than how to budget money, which is more important for those who live in towns. Only by informal discussions and indirect, tactful questioning will it be possible to get some indication of how the family budgets are used. It is particularly important to find out if money is spent on special infant foods, what these are, and why they have been chosen. No nutrition education can begin unless this kind of information is known and taken into account.

## FIND OUT ABOUT ENVIRONMENTAL HYGIENE

Personnel must make a point of understanding the hygienic conditions in the households. If the general hygiene in the home is poor, a high rate of intestinal and other infections is to be expected. Conditions can be worse if methods of storing and handling food are also unsatisfactory. Clean food and clean utensils are essential for successful feeding and of supreme importance if the infant is not being fed from the breast. The bottles, cups, spoons, or other utensils used for artificial or supplementary feeding, how they are cleaned and where they are stored, and actual methods of preparing the food should all be investigated. Personal hygiene also should be stressed in nutrition education (Figure 27).

Figure 26. Observations in markets: a fruit market in Colombia.

Figure 27. The importance of personal hygiene should be stressed.

## MAKING THE PLAN

This will be based on all the information which has been collected. The most successful plan is the simplest, and involves the least change in traditional ways.

At this stage it should be known:

what mixtures of food are best to recommend and when they can and should be given;

where the mothers can be taught how to prepare them;

who will teach them;

how teaching can be followed up in the home;

where and how checks can be made on children's growth and development;

what records should be kept and how this has been organized;

who will be responsible for assessing the success of the program.

To repeat, the recommended mixes the mothers will be asked to prepare and feed their children should be based on their own local foods, available within their budget, and related to any specific nutritional problem in the area.

When a few simple recipes for mixes have been formulated, it is recommended that they be tried on a few children in one or two meals daily. These could be staff children or children in some cooperative families. A great deal can be learned from such trials; for instance, how the children like it; whether the stools change in smell, frequency, or consistency, which the mothers may notice and complain about; how much food can be given at one time; how long it should be stored before it spoils; and so on. The children who are given the food should be supervised closely during the week or weeks it is being tested, so other mothers can be informed about the children's reaction to the new mixtures.

The basic food in any mix should be a local cereal supplemented with one of the other foods easily obtainable in quantities, as suggested in the latter part of this manual. If other supplementary foods are available through a clinic or distribution center, mothers should be shown how to use these to the best advantage, but it is not advisable to let them become too dependent on expensive imported supplies (Table 16).

## USING THE PREVENTIVE PROGRAM

Plans for improvement should include aspects of both health and food, of course, but the way it is used depends on local conditions. Ideally, any plan should be part of an integrated health service. In this way, mothers on visits to the local clinic, agriculture center, or any other community meeting place can be taught what they should do and followed up with home visits by the health worker or agricultural auxiliary.

Suggestions on what may be taught and how it might be done are given in Chapter 8.

School meals schemes, clubs for women, girls, or the male family members also can be part of a plan for general nutrition education. In a coordinated program, all members of the family can be taught the same principles, even if in practice they are applied in different ways.

Success may be measured by the improvement in the health of the children. Reduction in mortality rates, a decrease in the incidence of infections and parasite infestations, and improvements in growth rates as recorded on clinic weight charts are some of the objective signs.

Health workers, agricultural auxiliaries, and other personnel should remember that parents learn best through examples set by instructors, discussions or observation, and participation in demonstrations, rather than via formal lectures.

It is unlikely that any health worker will be in a completely isolated community. The program designed for one area should be consistent with over-all plans for the county or region, but should have special application to the needs of the community where it is in operation. There might be other auxiliaries in the area, perhaps working in the fields of agriculture or community development, and their work can be coordinated with the general improvement plan. Each auxiliary should be part of a team in which each member knows how his work fits in with the work of the other members.

For economic reasons, once a plan has been established in a small community, only one trained auxiliary might be left to operate it. This person should be supervised by some person who makes regular visits to the district to check the work being done, give advice, make suggestions, listen to or promote ideas, and leave a feeling of confidence in the results of the work.

# Chapter 14

# Using an Infant Feeding Program

## IN DEVELOFED COUNTRIES

Although many different infant-feeding patterns have been recommended in industrialized societies, they all have a common theme, based on the nutritional needs of the infant. The schedule or plan for infant feeding given here is one usually followed in a European country. It is shown diagramatically in Figure 28.

And now we will repeat several points that already have been made.

1. Only breast milk, if available, should be given up to the age of six months. From three to four months, the infant is gradually introduced to other foods, and at eight months breast-feeding usually stops and the baby is fed fresh cow's milk, or its equivalent.
2. If breast milk is not available, or is in insufficient supply, a breast-milk replacer is used. It is either a modified milk or a humanized milk designed to resemble breast milk as much as possible.
3. From three to four months, other infant foods or gruels are introduced in place of some of the milk foods (see Chapter 11). This pattern continues throughout the first year. At four months, the infant usually has four feedings of milk per day with some juice or purée, usually of fruit, added to one of them.
4. At about five to six months, one meal in the day consists of very finely minced or chopped fish, egg, liver, or meat. At this time, small quantities of yogurt or porridge made with whole cow's milk are introduced.
5. At about six months the infant might have two meals of breast milk or milk formula and porridge or another food, finely chopped or puréed, for the other two meals.
6. At about eight months, the varieties of chopped meat, fish, liver, and vegetables are extended, and at about one year the food is of the adult type.

In Sweden, and many other countries with temperate climates, supplements of vitamins and sometimes of iron also are given.

1. At four weeks: Vitamins A and D and sometimes vitamin C are given as drops, continued throughout the first year, and then, except during the

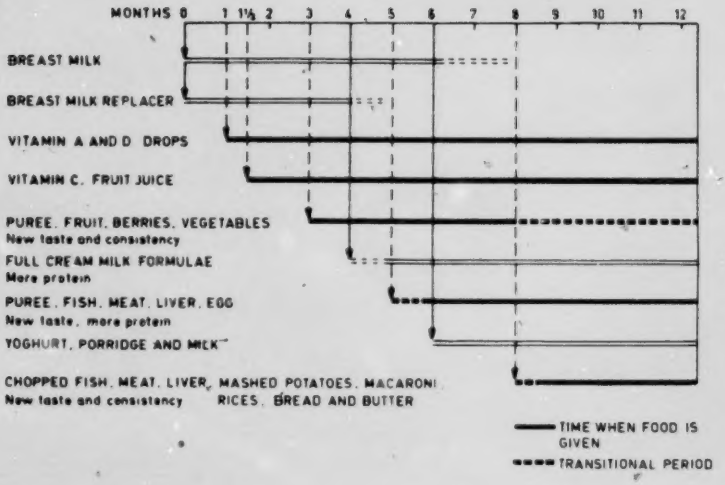

MONTHS 0 1 1½ 2 3 4 5 6 7 8 9 10 11 12
BREAST MILK
BREAST MILK REPLACER
VITAMIN A AND D DROPS
VITAMIN C. FRUIT JUICE
PUREE. FRUIT. BERRIES. VEGETABLES
New taste and consistency
FULL CREAM MILK FORMULAE
More protein
PUREE. FISH. MEAT. LIVER. EGG
New taste. more protein
YOGHURT. PORRIDGE AND MILK
CHOPPED FISH. MEAT. LIVER. MASHED POTATOES. MACARONI
New taste and consistency RICES. BREAD AND BUTTER
TIME WHEN FOOD IS GIVEN
TRANSITIONAL PERIOD

Figure 28. An infant feeding program in an industrialized country. (Courtesy Dr. L. Wranne, Orebro, Sweden).

summer, up to the age of three years. In more temperate or tropical climates, some modifications of this scheme are made. If the infant gets sufficient sunshine and plenty of vitamin A-rich food sources are available, concentrates of these vitamins probably can be omitted.

2. At six weeks: Fruit juice with its vitamin C supplements milk formulas. Although usually citrus, it could be papaya, mango, or one of many other fruits in tropical regions.

3. At three months: Amounts are increased, beginning with a small spoonful, and fruit purées replace juice. Gradually, the purées give way to mashed fruits and then to soft fruit to chew. This introduces new tastes and begins training to chew.

The quantities depend on the infant. The labels on cans of milk or baby food indicate the quantities related to the infant's weight, and should be followed precisely, allowing for variations in weight.

The proof for an adequate, but not excessive, diet lies in the satisfactory growth of the infant as shown on his weight chart.

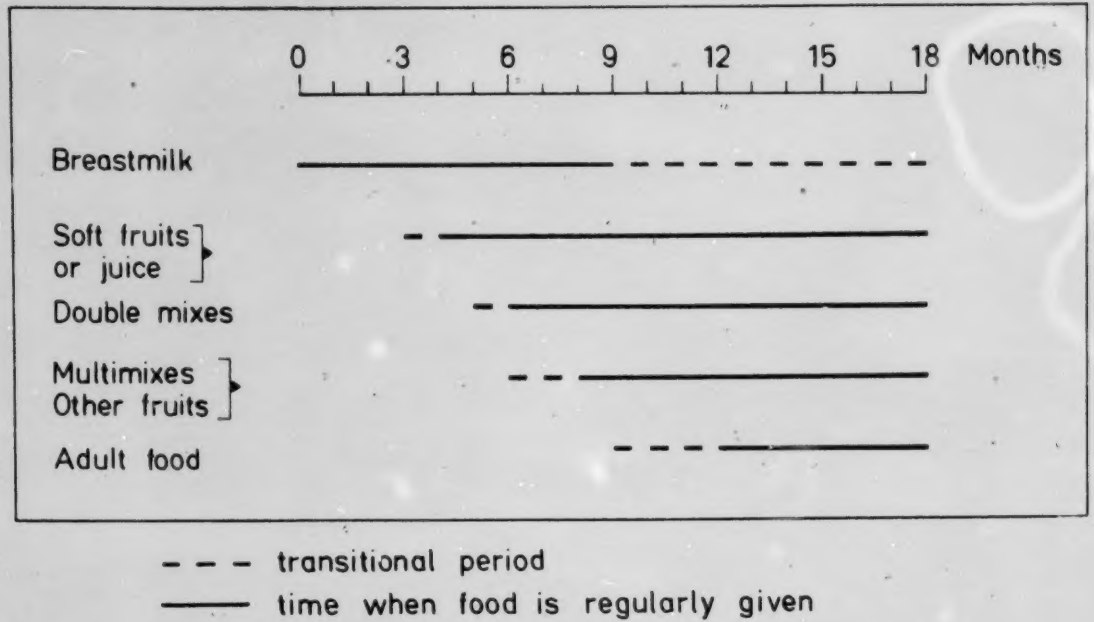



Figure 29. A feeding plan during weaning in a developing country.

## FOR "COUNTRY X"

Let us consider a country whose basic staple is rice. Fish, eggs, and meat are available, as is a variety of legumes. Fruit and vegetables of different kinds are grown but are not always used, even though they are inexpensive. Fresh milk cannot be bought readily, but it is available in powdered form or as an evaporated-milk product.

A suggested plan for feeding infants in such a country during weaning is shown diagramatically in Figure 29.

*From birth:* Breast milk, given on demand, will be the infant's only food for about four to six months. If for some reason this is impossible, a satisfactory substitute must be found. Artificial feedings should be given at four-hour intervals, five times a day. These might be based on fresh cow's milk, as suggested in Table 15, but a milk-powder formula, if it can be afforded, might prove more satisfactory, especially if it is a complete food. The manufacturer's instructions must be very carefully followed and the mixture prepared with high standards of cleanliness for both the food and the utensils, as discussed previously.

The milk powder should be fortified with vitamins A, D, and C, probably as concentrates, and should contain iron, as well.

If the infant seems hot and thirsty, extra fluids may be required. The only safe fluid is cooled, boiled water, given after a feeding of milk.

*About four to six months:* At four months, small amounts of additional foods should be introduced after one, or perhaps two, milk feeds each day. A soft, well-cooked double mix also is satisfactory. This might be soft-cooked rice, into which some finely flaked fish has been beaten to make it smooth. The mix should be fed from a clean cup, using a small spoon.

The amount of breast milk available at this time cannot be known with certainty, but if it were only 600 ml, this would contain about 75 percent of the day's total requirements. The remaining 25 percent must come from additional food. Because at this age the bulk factor is important, a double mix adjusted for bulk, as in Table 17, should be selected for use during the day. The second food depends on local supplies and cost, but a suitable mix might be two tablespoons of soft, cooked rice with one teaspoon of flaked fish and one teaspoon of butter or oil. This amount of food should supply the remainder of the infant's needs, especially if no other suitable milk formula is available.

*At six months:* By this time, the quantity of additional food will have been increased gradually and be given after two or three of the milk feedings. After one milk feed, for instance, a small piece of soft fruit, such as papaya, mango, or orange, is suitable.

As a child is fed different foods, it will become accustomed to new flavors. It is best to try out only one new food at a time. Even if a child appears not to like it at first and spits it out, the mother should keep trying with the same kind of food for several days.

Another suitable mix for this age, after one milk feeding, is two tablespoons of cooked rice into which a small egg and one teaspoon of butter or oil have been beaten while the rice is hot. The heat is sufficient to cook this small amount of egg. Alternatively, half a hard-cooked egg could be mashed finely with the rice and butter. These mixtures can be adapted from the family pot and, if so, need not to be cooked separately.

*At about nine months:* By this time, similar types of additional foods and mixes are given at least three times after the milk feedings, but other foods can be added to make multimixes. These can be chopped dark-green leaves, tomatoes, red or yellow vegetables, and small amounts of fruits offered as snacks. Because by now teeth have begun to appear, the food can be chopped more coarsely to encourage the infant to chew. One of the meals might be two tablespoons of cooked rice, one teaspoon of flaked fish or mashed sardines, one teaspoon of oil or butter, with one tablespoon of chopped dark-green leaves, pumpkin, or tomato.

*At about 12 months:* By this age, the child can eat most of the foods being cooked for the rest of the family. His share, though smaller than the adults', must have a larger proportion of the side dish, whether it is a soup, stew, or sauce, because this food usually contains the best protein ingredient in the meal. Examples of meals and mixes for this age can be found later in this manual. It is important to give the child solid food after milk feeds at least three times a day, because it is difficult at this age to eat enough food for energy needs if it is offered only once or twice in the day. Small snacks of fruit or some legume dish, such as a bean-cake, can be given.

The quantity for one meal might be three tablespoons of cooked rice with one tablespoon of well-cooked beans, one teaspoon of chopped, lean meat, and one tablespoon of dark-green, leafy vegetable or tomato.

*From 1 to 2 years:* During this time, the mother usually stops breast-feeding. For the benefit of both mother and child, this should be done gradually. Instead of four breast-feedings, or their equivalent, two and then only one should be given per day. However, it is difficult to be precise about the number of feedings, because the child may still be carried on the mother's back and fed on demand, with smaller and smaller amounts of milk. As the milk supplies decrease, the mixed foods given with them must be increased. Examples of meals for this age are given in this manual; at least once a day there should be a complete cooked meal. At other times, the meal may be more simple, and fruit or other snacks can be given in between.

The quantity of one meal might be:

| | |
|---|---|
| Cooked rice | 1 cup |
| Soy sauce | a little to taste |
| Fresh-cooked fish | 1 tablespoon |
| Dark-green leaves | ½ cup |
| Vegetable oil or ghee | 1 teaspoon |
| Piece of papaya or mango | |

Proof that the child is receiving enough food is a satisfactory increase in weight, which shows on his clinic chart. It should be remembered that the activity of a child has a large influence on energy needs, and an active child will need more food than does a child who does not run about and play.

## Daily Meal Plans

Daily meal plans can be made for infants or children of any particular age by selecting recipes for different mixes that use foods similar to those going into the family pot. Two examples of daily plans are given in Tables 18a and 18b.

All the recipes are of adequate protein value for the young child, if enough is eaten, and the bulk and consistency of the meals are suitable for the age group.

TABLE 18a. SUGGESTED MEAL PLAN FOR INFANTS ABOUT 9 MONTHS OF AGE (average weight 8.3kg)

| *Breast milk presumed to be available per day, 500 ml* | *g/ml* | *Energy kcal* | *Protein g* | *Vit.A equiv. µg* | *Vit.C mg* |
|---|---|---|---|---|---|
| *Morning feeding:* Breast milk | 250 ml | 168 | 3.0 | 168 | 10.8 |
| *Midday: Double mix* | | | | | |
| Maize meal: 1/2 milk tin | 75 | 272 | 7.1 | — | — |
| Dried fish, when soaked: 2 tspn | 10 | 13 | 2.9 | — | — |
| Red palm oil: 1 tspn | 5 | 45 | — | 100 | — |
| *Afternoon snack:* | | | | | |
| Piece of orange—about 1/4 | 30 | 16 | 0.2 | 1 | 14.0 |
| *Afternoon meal: Multimix* | | | | | |
| Maize meal: 2 heaped Tbspns | 50 | 181 | 4.8 | — | — |
| Bean flour: 1 heaped tspn | 10 | 34 | 2.2 | — | — |
| Finely chopped green leaves: 1/2-1 tspn | 2 | 1 | — | 6 | <1 |
| Red palm oil: 1 tspn | 5 | 45 | — | 100 | — |
| *Evening feeding:* Breast milk | 250 ml | 168 | 3.0 | 168 | 10.8 |
| Totals for day | | 943 | 23.2 | 543 | 35.6 |
| Average requirements per day | | 950 | 20.0 | 300 | 20 |

(See also Table 6 and notes with Table 18b)

## TABLE 18b. SUGGESTED MEAL PLAN FOR INFANTS ABOUT 1 YEAR OF AGE (average weight 11.4 kg)

| *Breast milk presumed to be available per day, 200 ml* | *g/ml* | *Energy kcal* | *Protein g* | *equiv. µg* | *Vit. C mg* |
|---|---|---|---|---|---|
| *Morning feeding: Breast milk with Double mix* | 100ml | 67 | 1.2 | 67 | 4.3 |
| Rice: 3 matchboxesful—level | 60 | 211 | 4.2 | — | — |
| Small egg—or 1/2, if hard cooked | 30 | 47 | 3.9 | — | — |
| Oil: 1 tspn | 5 | 45 | — | — | — |
| *Mid-morning snack* | | | | | |
| Orange: about 1/2 | 60 | 32 | 0.4 | 2 | 28 |
| *Midday meal: Multimix* | | | | | |
| Rice: (1/2 cup cooked) Raw weight | 60 | 211 | 4.2 | — | — |
| Beans, peas, or dhal: 1 heaped Tbspn | 20 | 68 | 4.4 | — | — |
| Dark-green leaves: about 1 Tbspn | 10 | 5 | 0.5 | 30 | <4 |
| Tomato: a piece | 10 | 2 | 0.1 | 2 | <3 |
| Oil: 1 tspn | 5 | 45 | — | — | — |
| *Afternoon snack:* | | | | | |
| Pawpaw (papaya): a piece | 90 | 35 | 0.5 | 270 | 45 |
| *Evening meal: Breast milk with Multimix* | 100ml | 67 | 1.2 | 67 | 4.3 |
| As at midday | | 331 | 9.2 | 32 | <7 |
| | | 1166 | 29.8 | 470 | 81.6 |
| | | 1180 | 21 | 250 | 20 |

(See also Table 6 and notes, below)

NOTES (for Tables 18a and 18b)

1. Proportions for ingredients are based on Table 17.
2. The amount of breast milk is approximate and probably maximum for this age. This plan is suitable if the mother is away from home for part of the day. If at home, breast milk will be given at more frequent intervals. Breast milk, with a score of 100, makes a valuable contribution to the day's protein intake.

3. If another vegetable oil replaces red palm oil in Table 18a, it would not contribute vitamin-A value (see Table 10). In Table 18b, vitamin-A value can be increased if ghee, butter, or red palm oil replaces the vegetable oil.
4. Vitamin-C values for double and multimixes depend on preparation and cooking methods.
5. A few nutrient values have been calculated. Meeting all requirements every day usually is not possible or practicable. A variety of foods must therefore be used over a week to make certain that values are met, on average, over the longer period.
6. It is unlikely that three different meals would be cooked each day. Two meals in the day would probably be similar—see Table 18b.
   Although amounts cannot be precise, requirements increase whenever there is added stress, such as result from infection, fever, and parasites. Any plan should cover these childhood stresses.

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# Chapter 15

# The Use of Recommended Mixes for Conventional Meals

For the basic mixes in this Chapter, refer to Tables 17a and 17b. Recipes are arranged according to the staple food on which the mixes are based and these follow the order given in the Tables.

The amounts of ingredients to use in simple mixes are shown first, followed by those suitable for more conventional recipes based on each staple food. The ingredient proportions in the more conventional recipes sometimes differ from those in the double mixes, which were calculated as ideal mixes. A greater variety of ingredients is often used in the recipes and the mix more closely resembles the traditional meal that might come from the family pot.

The *energy* value for each recipe has been calculated and is shown.

The *protein* value of all the mixes and recipes is similar and is adequate for young children, including those exposed to additional stresses, such as infections and infestations.

The *bulk* of the meal has also been considered for its suitability in relation to its energy value.

The *quantity* for each ingredient in the recipe is given as gram-weight of the edible portion of the food, ready for conversion by the health worker into the local household measure of volume.

Only low-cost ingredients have been used in the recipes. Most of them can be grown at home or are readily available at the local market. All are likely to be in the household for the family pot.

The methods of preparation are typical of the regions where the foods are traditional. The same ingredients, used in the same proportions, have the same energy and protein value if cooked by a different method to suit the tastes of another community. This presupposes that the different methods do not use quantities of extra oil or fat. Fats or oils, however, are expensive in many communities or are hard to find; housewives should be encouraged to use even a little of these ingredients.

It is not possible to give here precise instructions about the quantity of food to be given to an individual child for growth and development. This depends on age, the extent of physical activities, appetite, and the presence or absence of infections.

If the given recipe provides too much food, less of it might be prepared, but the amounts of all the main ingredients must be reduced in the same proportion. If, for example, these are halved, the energy and bulk also are halved, but the consistency and the protein value remain the same. Alternatively, the original recipe can be prepared as usual then shared by more than one member of the family.

If, on the other hand, the given recipe is too small, and more food is needed for a meal, the amounts of all the main ingredients should be increased by the same proportion. If they are doubled, the energy value and bulk are twice as much, but, as before, the consistency and protein value are unchanged and still are suitable for the young child.

Some of the recipes were prepared by international postgraduate students of nutrition as part of their training. Their aim was to design low-cost meals for young children in terms of local foods in rural communities of their own countries. The meals were to provide a child between one and two years of age with about one-third of a day's energy needs and be of suitable protein value. They show how double mixes or multimixes can be adapted for conventional recipes. To judge if the planned meals were suitable in bulk, consistency, flavor, and cost, they were prepared, cooked, tasted, and the costs estimated in local terms. The results were discussed and, if found satisfactory, the recipes were approved and recommended for future use. Other recipes were contributed by colleagues working in many different parts of the world.

If the recipes are studied, it will be seen that, though they represent many different regions in the world, the basic ingredients are often similar. The methods of preparation and cooking give them their traditional characteristics.

Health workers and others in communities in different countries should select from this collection, or work out for themselves other recipes that use local foods to suit the tastes and customs of the people. It is hoped that the information given here will help them do so.

NOTE: In all of the recipes for mixes, the most economical amount of supplement is used, but more may be added.

All of the recommended multimixes can be made by adding some leafy green, red, or yellow vegetables or tomato to any of the mixes, or by serving fruit after the meal.

In the more conventional recipes, the proportions of ingredients sometimes differ from those for double mixes that were calculated as ideal, partly because of the variety of ingredients used, which more closely resemble "family-pot" meals. To each recipe, add water, salt, and/or spices, when and if appropriate, in the traditional manner of the area. Remember not to add too much water, because it will overdilute the food.

Only the weights of the ingredients are given in most of the recipes. Before using them, please read both the introduction to this Chapter and Chapter 9, "Measurement of Foods."

## OATS

*(See Note, p. 128)*

### DOUBLE MIXES

ADD: 10g oil **or** 5g oil and 10g sugar **or** 20g sugar

| TO: | | and | |
|---|---|---|---|
| | 65g oats | | 10g egg |
| | 65g | | 5g dried skimmed milk |
| | 55g | | 10g dried whole milk* |
| | 65g | | 15g fresh fish* |
| | 65g | | 10g chicken/lean meat |
| | 60g | | 10g soybean* |
| | 65g | | 5g legume |

***or** its equivalent

See also notes in Chapter 12.

Each mix provides about 350 kcal.

75g oats and 5g legume with 5g oil **or** 10g sugar provide about the same energy and protein value.

Traditionally, oats or oat products are used only as a double mix, most frequently to make a porridge with water, milk, or a mixture of both. Oat multimixes are unusual and therefore no recipes are given for them.

## WHEAT

*(See Note, p. 128)*

### DOUBLE MIXES

ADD: 10g oil **or** 5g oil and 10g sugar **or** 20g sugar

| TO: | | and | |
|---|---|---|---|
| | 65g wheat flour | | 25g egg |
| | 65g | | 10g dried skimmed milk |
| | 55g | | 15g dried whole milk* |
| | 70g | | 30g fresh fish* |
| | 65g | | 20g chicken/lean meat |
| | 60g | | 15g soybean* |
| | 65g | | 10g legume |

***or** its equivalent

See also notes in Chapter 12.

Each mix provides about 350 kcal.

80g wheat and 10g legumes with 5g oil **or** 10g sugar provide about the same energy and protein value.

One double-mix recipe could be (350 kcal):

| | |
|---|---|
| Semolina | 65g (1/2 milk tin) |
| Egg | 25g (1 small egg) |
| Sugar | 20g (1 level Tbspn) |

1. Mix the semolina and sugar with a little cold water.
2. Add the rest of the water and bring to a boil while stirring. Beat in the egg.
3. Cook gently for a few minutes.
4. Feed to the infant from a spoon.

**1. Double mix**

| | |
|---|---|
| Wheat flour | 90g |
| Onion | 30g |
| Yogurt | 100g |

1. Make chapatti of flour, salt, and water.
2. Slice onion.
3. Serve chapatti with onion slices and yogurt.

(Pakistan, 335 kcal)

**2. Double mix**

| | |
|---|---|
| Wheat flour | 35g |
| Lean meat, chicken, or fresh fish | 10g |
| Ghee or oil | 5g |

1. Make bread or chapatti with some water, salt, and flour.
2. Mince or cut finely the cooked meat or fish and mix with the oil.
3. Use oil-meat/fish mixture as a sandwich filling with the bread or chapatti.

(India/Pakistan, 160 kcal)

**3. Double mix**

| | |
|---|---|
| Whole-wheat flour (for bread) | 65g |
| Beans, horse or broad | 60g |
| Oil | 5g |

For flavoring: small amounts of leek, spring onion, salt, coriander seeds.

1. Soak beans until the skins can be removed easily. Discard the skins.
2. Grind beans to a paste and form into small cakes.
3. Fry in hot oil.
4. Serve on bread as a sandwich.

(Egypt, 460 kcal)

**4. Double mix**

| | |
|---|---|
| Whole-wheat flour (for bread) | 50g |
| Sesame seed (lightly roasted) | 30g |
| Lemon juice, Garlic } for flavoring | |

1. Pound sesame seeds to a paste, using the seasonings and hot water as required: adjust flavoring.
2. Dry the bread gently until crisp.
3. Serve sesame paste with crisp bread as a snack.

(Egypt, 350 kcal)

**5. Multimix**

| | |
|---|---|
| Wheat flour | 40g |
| Bean flour | 20g |
| Sesame flour (or seed) | 20g |

1. Mix the dry ingredients in a saucepan.
2. Add a little cold water and stir well to make a smooth paste.
3. Stir in about 1 cup of water.
4. Place saucepan on heat and bring ingredients to a boil.
5. Cook gently for 4 to 5 minutes.
6. Pour into bowl or dish and serve at once.

(Turkey, 330 kcal)

**6. Multimix**

| | |
|---|---|
| Semolina | 25g |
| Black gram | 25g |
| Sugar | 5g |
| Dried skimmed milk | 5g |

1. Wash the beans well, put in pot with water and boil until almost soft.
2. Sprinkle in the semolina and sugar and continue cooking a little longer.
3. Stir in the dried skimmed milk and mix well.
4. Serve.

(India/Pakistan, 210 kcal)

**7. Multimix**

| | |
|---|---|
| Wheat flour as bread | 60g |
| Groundnuts | 20g |
| Sesame seeds | 10g |

1. Roast the groundnuts lightly, remove and discard the skins.
2. Grind the nuts and lightly toasted sesame seeds to a very fine paste.
3. Add salt to taste.
4. Spread the paste on bread and serve.

(Sierra Leone, 360 kcal)

**8. Multimix**

| | |
|---|---|
| Wheat flour | 75g (1 heaped sini [local coffee cup]) |
| Dried skimmed milk | 5g (1 teaspoon, heaped) |
| Field-pea flour | 20g (2-3 teaspoons, heaped) |

1. Mix the wheat, pea flour, and dried skimmed milk with water.
2. Bring to a boil and cook gently for 15 to 20 minutes.

(Ethiopia, 350 kcal)

**9. Multimix**

| | |
|---|---|
| Whole-wheat flour (for bread) | 60g |
| Beans, horse or broad | 40g |
| Lentils | 5g |
| Oil | 5g |
| Tomato (1) | 40g |
| Lettuce leaves | 20g |
| Lemon juice | |

1. Soak beans, change water, and boil gently with washed lentils until very soft and most of the water has been absorbed.
2. Season with salt, pepper, lemon juice, and oil.
3. Serve with flat, round bread, made from flour, with lettuce leaves and raw tomato.

(Egypt, 350 kcal)

**10. Multimix**

| | |
|---|---|
| Wheat bread, brown | 30g |
| Broad beans | 25g |
| Cheese (soft, skimmed-milk) | 10g |
| Tomatoes | 30g |
| Oil | 10g |
| Orange | 100g |
| Sugar | 10g |

1. Wash the beans and stew in water very slowly until soft.
2. Season with the oil, salt, and lemon juice to taste.
3. Serve the beans with the bread, tomatoes, and cheese.
4. At the end of the meal, serve the fruit, with sugar if needed.

(Egypt, 400 kcal)

**11. Multimix**

| | |
|---|---|
| Wheat flour, brown | 50g |
| Green gram | 25g |
| Spinach (dark-green leaves) | 50g |
| Carrots | 25g |
| Banana (skinned) | 50g |
| Ghee (or vegetable oil) | 5g |
| Milk (buffalo) | 50g |

1. Prepare a dough with the flour, a little salt, and water. Bake into 2 small chapattis. Add the ghee and serve hot.
2. Clean and wash the green gram; cook in a little water until soft, with salt, a pinch of turmeric, and cumin seeds.
3. Wash and chop the spinach and add to the green gram. Continue cooking until the spinach is soft. The mixture should be semisolid and well blended when served. Some of the ghee can be used to fry the spices and add to the cooked beans.
4. Serve the milk as a drink.

(India, 430 kcal)

**12. Multimix**

| | |
|---|---|
| Wheat bread, brown | 45g |
| Rice | 25g |
| Green, leafy vegetable | 100g |
| Yogurt | 150g |
| Oil | 10g |

1. Wash and cook the rice in about twice its volume of water. When almost cooked, add the washed and chopped vegetable.
2. Add oil and serve the rice mixture with the bread and yogurt.

(Iran, 410 kcal)

**13. Multimix**

| | |
|---|---|
| Semolina (couscous) | 50g |
| Kidney beans | 15g |
| Dark-green vegetables | 50g |
| Onion | 25g |
| Soured skimmed milk (leban) | 100g |
| Oil | 10g |
| Tomato | 25g |

1. Steam the semolina for couscous.
2. Fry the sliced or chopped onion with the tomato in the hot oil. Add soaked kidney beans, the washed and chopped vegetable, and a little water. When cooked, serve with the couscous.
3. Serve the soured skimmed milk as a drink.

(Morocco/Algeria, 405 kcal)

**14. Multimix**

| | |
|---|---|
| Wheat bread, brown | 60g |
| Lean meat | 25g |
| Oil | 5g |
| Dark-green leaves | 30g |
| Tomato | 30g |
| Orange | 100g |
| Sugar | 10g |

1. Prepare the meat and fry in hot oil until brown.
2. Wash and chop the green leaves; add to the meat with a little water. Wash and cut the tomato and add to the mixture. Season with salt and let cook gently until the meat is soft (about 1/2 to 1 hour).
3. Serve the stew with bread. Serve the orange and sugar as dessert.

(Syria, 380 kcal)

## RICE

*(See Note, p. 128)*

### DOUBLE MIXES

ADD: 10g oil **or** 5g oil and 10g sugar **or** 20g sugar

| TO: | | | |
|---|---|---|---|
| | 65g rice | and | 30g egg |
| | 65g | | 15g dried skimmed milk |
| | 45g | | 25g dried whole milk* |
| | 70g | | 30g fresh fish* |
| | 65g | | 25g chicken/lean meat |
| | 55g | | 20g soybean* |

***or** its equivalent

**See also notes in Chapter 12.**

**Each mix provides about 350 kcal.**

65g rice and 25g legume with 5g oil **or** 10g sugar provide about the same energy and protein value.

One double mix recipe could be (350 kcal):

| | |
|---|---|
| **Rice** | 70g (2 heaped Tbspns) |
| **Sardine** | 30g (3 sardines drained of oil) |
| **Oil** | 10g (2 tspns) |

1. Wash the rice and cook in water until soft.
2. Beat with a wooden spoon until creamy.
3. Remove all the bones from the sardine and beat into the rice with oil.
4. Feed to the infant with a spoon.

**15. Double mix**

| | |
|---|---|
| Rice | 60g |
| Cowpeas | 40g |
| Onion | 10g |
| Palm oil, red | 5g |

1. Soak beans, remove and discard skins.
2. Grind or pound beans until smooth.
3. Cream until light and fluffy.
4. Add salt, onion, and a little water, if necessary.
5. Fry by spoonsful in oil or fat.
6. Serve with rice (pap).

(Western Nigeria, 400 kcal)

**16. Double mix**

| | |
|---|---|
| Rice | 50g |
| Mung dhal | 50g |
| Ghee | 5g |

1. Mix rice and dhal; wash once or twice to clean.
2. Add water and cook gently in covered pan until rice is soft and water is absorbed.
3. Add ghee and salt to taste.

(India/Pakistan, 340 kcal)

**17. Double mix**

| | |
|---|---|
| Rice | 40g |
| Groundnuts | 10g |
| Cowpeas | 20g |

1. Roast groundnuts lightly, remove and discard skins, and grind nuts to a smooth paste.
2. Soak cowpeas overnight, remove testa and eyes, and cook gently in water until soft.
3. Add the groundnut paste to cooked cowpeas and mix well.
4. Wash the rice thoroughly. Cook in the usual way.
5. Serve cowpea mixture with rice, beaten smoothly together, if necessary.

**18. Multimix**

| | |
|---|---|
| Rice | 50g |
| Lentils | 40g |
| Lean beef | 20g |
| Onion | 30g |
| Cooking fat or oil | 5g |

1. Melt the fat and when it is hot, add the sliced onion. Fry a few minutes before adding the chopped or minced meat. When meat is browned, add a little water and seasoning and cook gently until tender.
2. Wash the rice and lentils until clean. Cook gently in about twice their volume of water until they are soft. Serve with the stew.
(North Africa, 445 kcal)

**19. Multimix**

| | |
|---|---|
| Rice | 75g |
| Lentils | 30g |
| Mutton or lean lamb | 15g |
| Ghee | 5g |
| Onion | 5g |

1. Wash rice and lentils until clean. Peel onion and add to rice and lentils. Add water about twice the volume of the vegetables and cook gently until rice and lentils are soft.
2. Mince the meat and fry with ghee. Add salt to taste. Add meat to the rice-lentil mixture and cook for 5 minutes. (Cheese, egg, fish, or curds can replace the meat. In some traditional dishes, the rice and lentils are in equal quantities.)
(Jordan, 400 kcal)

**20. Multimix**

| | |
|---|---|
| Rice | 80g |
| Groundnuts (dry) | 10g |
| Dried fish | 5g |

1. Add washed rice to the boiling, salted water.
2. Cook for 15 minutes.
3. Add pounded fish and groundnuts.
4. Cook for another 30 minutes.
(Gambia, 360 kcal)

**21. Multimix**

| | |
|---|---|
| Rice | 40g |
| Kidney beans | 50g |
| Lard | 10g |
| Soft cheese | 20g |

1. Clean and wash the beans.
2. Bring to a boil in salted water and boil gently until the water has nearly boiled away. Pound to a smooth paste.
3. Add lard and cook the beans slowly in a frying pan until they are a firm paste.
4. Serve with the soft cheese and rice, well washed and cooked in the usual way.

(Guatemala, 420 kcal)

**22. Multimix**

| | |
|---|---|
| Rice | 50g |
| Pulse | 50g |
| Ghee | 5g |
| Egg (1/2) | 25g |

1. Mix rice and pulse and wash once or twice.
2. Add water and cook gently in covered pan until rice is soft and water is almost absorbed.
3. Stir in beaten egg, ghee, and salt to taste.
4. Mix well.

(India/Pakistan, 360 kcal)

**23. Multimix**

| | |
|---|---|
| Rice | 100g |
| Potatoes | 30g |
| Ghee | 5g |
| Curry powder and salt to taste | |
| Dried skimmed milk | 5g |

1. Melt fat and add curry powder and salt.
2. Peel and slice the potato and add to the fat with a little water.
3. Bring to the boil and cook gently until potato is soft.
4. Wash the rice well and cook in twice its volume of water until soft.
5. Serve with the potatoes, and give the milk to drink.

(Pakistan, 440 kcal)

**24. Multimix**

| | |
|---|---|
| Parboiled rice | 40g |
| Groundnuts | 15g |
| Sesame seed | 30g |
| Red palm oil | 5g |

1. Clean and wash rice and soak for 1/2 hour.
2. Drain off water and pound rice to flour.
3. Rub and wash sesame seed, remove and discard husks; parch seed slightly and pound it to a paste.
4. Roast groundnuts lightly, discard the skins, and pound nuts to a paste.
5. Mix the rice, sesame seed, and groundnut pastes together in a mortar and add the red palm oil.
6. Dry the resulting flour well before storing it in a tin.
7. Cook 4 heaping Tbspns in 3/4 pt of water with salt, and feed 3 times per day per infant.

To improve the protein value, add the following whenever available:

| | kcal |
|---|---|
| 50g cassava greens | 455 |
| **or** 10 dried fish | 450 |
| **or** 50g egg | 510 |
| **or** 20g skimmed-milk powder (or equivalent) | 510 |

(Sierra Leone, 440 kcal)

**25. Multimix**

| | |
|---|---|
| Rice | 75g |
| Cowpeas | 25g |
| Milk | 75g |
| Sesame seed | 5g |

1. Soak cowpeas overnight and remove the skins.
2. Wash peas thoroughly, put into freshly salted water, and cook slowly until almost soft.
3. Add thoroughly washed rice and the sesame seed.
4. Continue cooking until rice is soft.
5. Mix well to combine ingredients and serve with the milk as a drink.

(Sierra Leone, 425 kcal)

**26. Multimix**

| | |
|---|---|
| Rice | 60g |
| Egg | 20g |
| Spinach, edible portion | 10g |
| Sesame-seed oil | 5g |
| Sesame seed | 2g |
| Sugar | a pinch |
| Garlic | |

1. Wash rice and cook it in about 1⅓ times its volume of water until it is just soft.
2. Wash spinach and remove the stalks and roots. Blanch for about 1 minute in a small amount of boiling water. Drain off water and chop as wished. Add oil, sesame seeds, sugar, soy sauce, and garlic for flavor. Serve with rice.
3. Egg custard: Beat the egg with an equal volume of water. Add seasonings, such as sesame seed, nuocnam, green onion, etc. Steam or cook in a double boiler until set (sometimes a little minced meat, soybean curd, and chopped onion are used).

(Korea, 300 kcal)

**27. Multimix**

| | |
|---|---|
| Rice | 100g |
| Egg | 25g |
| Fresh fish | 15g |
| Soybean sauce to taste | |
| Carrot | 10g |
| Dark-green leaves (cabbage) | 10g |

1. Wash rice and cook in about twice its volume of water until soft.
2. Stew the fish gently with soy sauce and serve.
3. Wash cabbage and carrot and cut into small pieces. Put into boiling water and cook for 5 minutes. Beat egg and pour in, stirring constantly. Cook 3 minutes more. Add soy sauce and serve as a soup.

(Korea, Chinese style, 430 kcal)

**28. Multimix**

| | |
|---|---|
| Rice | 90g |
| Soy sauce to taste | |
| Spinach, edible portion | 60g |
| Fresh-fish fillet | 30g |
| Vegetable oil | 5g |
| Banana | 40g |

1. Wash rice and boil in only the amount of water that will be absorbed by the time the rice is soft. Dice the fish and add to the rice. Season with salt.
2. Wash and chop the spinach. Add the oil and soy sauce. Cook for a few minutes until just tender, and serve with the rice.

(Korea, Chinese style, 465 kcal)

**29. Multimix**

| | |
|---|---|
| Rice | 80g |
| Fresh fish (carp) | 25g |
| Fermented soybean | 5g |
| Ginger to flavor | |
| Peanut oil or lard | 5g |
| Mustard leaf | 40g |

1. Wash the mustard leaves, remove the stalks, and cook in a small amount of water.
2. Steam the carp with the ginger and mashed soybean.
3. Cook rice and serve with vegetables and fish.

(Malaysia, Chinese style, 370 kcal)

**30. Multimix**

| | |
|---|---|
| Rice (cooked as a main side dish) | 70g |
| Fish (fresh) | 20g (side dish I) |
| Fat for frying | 5g |
| Cajan (spinach), steamed | 50g (side dish II) |
| Sambal (Indonesian spicy sauce) | to taste |
| Banana (raw) | 50g (dessert) |

(Indonesia, 390 kcal)

**31. Multimix**

| | |
|---|---|
| Rice | 75g |
| Fresh fish | 50g |
| Spinach | 30g |
| Yam, edible portion | 30g |
| Tomato | 75g |
| Spring onion | 30g |
| Vegetable oil | 15g |
| Piece of ginger | |

1. Wash rice and cook gently in about 3 times its volume of water until all water is absorbed and the rice is soft.
2. Wash fish and salt it. Wash and chop vegetables. Grind ginger.
3. Heat oil in pan, add the ginger, onion, fish, and yam.
4. Add 2 to 3 cups of rice water. When it begins to boil, add spinach and tomatoes. Add salt to taste. Boil for 5 minutes and serve.

(Philippines, 425 kcal)

**32. Multimix**

| | |
|---|---|
| Rice | 90g |
| Fresh sea fish | 20g |
| Fresh green beans | 10g |
| Carrot | 10g |
| Lard | 5g |

1. Wash rice and cook gently until soft in about twice its volume of water.
2. Fry the fish in the lard. Add the washed and chopped beans and carrots. Add salt to taste and a small amount of water. Serve with the rice.

(Thailand, 395 kcal)

**33. Multimix**

| | |
|---|---|
| Rice | 65g |
| Cowpeas | 15g |
| Salt fish | 20g |
| Fat | 5g |
| Onion | 5g |
| Sweet potato | 20g |
| Lemon or lime juice | |
| Sugar | 10g |

1. Cook peas in boiling, salted water. When peas are almost done, add rice and cook until grains are soft.
2. Boil salt fish, pound it, and fry in fat until crisp.
3. Add sliced onions and seasonings. Add water to make gravy.
4. Boil sweet potato and serve sliced with peas and fish mixture.
5. Serve lemon juice, sugar, and water as a drink.

(Barbados, 410 kcal)

**34. Multimix**

| | |
|---|---|
| Rice | 60g |
| Small, dried fish (Ikan bilis) | 5g |
| Vegetable oil | 15g |
| Sweet potato leaves (dark-green) | 30g |
| Soy sauce to taste | |
| Papaya | 60g |

1. Wash the rice and cook it gently until all the water is absorbed. Season with the soy sauce.
2. Fry the dried fish in the oil until crisp. Pound the cooked fish and, if possible, pass it through a coarse sieve.
3. Wash the potato leaves. Boil in a little water seasoned with salt until soft. Cut or chop and serve with rice and the fish.
4. Prepare and serve the papaya raw.

(Malaysia, 380 kcal)

**35. Multimix**

| | |
|---|---|
| Rice | 90g |
| Groundnuts (shelled) | 10g |
| Dried salt fish | 10g |
| Tomatoes | 30g |
| Onion | 10g |
| Peppers, green | 5g |

1. Roast groundnuts lightly, remove and discard skins, and pound nuts in a mortar.
2. Cut dried fish into portions, wash in cold water, then soak in hot water for 15 minutes.
3. Cook fish in salted water for approximately ½ hour.
4. Add pounded tomatoes and water.
5. Add chopped peppers and sliced onions.
6. Boil gently for 10 minutes, then add well-washed rice.
7. Cook 20 minutes and add groundnuts.
8. Cook a further 10 minutes and serve.

(Gambia, 400 kcal)

**36. Multimix**

| | |
|---|---|
| Rice | 40g |
| Lentils | 25g |
| Lean beef | 15g |
| Vegetable oil | 10g |
| Tomato | 10g |
| Lettuce | 5g |
| Cucumber | 10g |
| Lime juice, fresh | 10g |
| Sugar | 15g |

1. Season the beef with salt, vinegar, onion tops, and herbs.
2. Soak the lentils and cook until almost soft.
3. Heat fat, add the meat, and cook until brown. Add the lentils, and cook for a few minutes. Add the washed rice and fry for a few minutes before adding water equal to twice the volume of the rice.
4. Bring to a boil and cook gently until all water has been absorbed. Serve with a salad of tomato, cucumber, and lettuce.
5. Prepare a fruit drink using the lime juice, sugar, and water.

(Caribbean, 380 kcal)

**37. Multimix**

| | |
|---|---|
| Rice | 60g |
| Kidney beans | 35g |
| Beef, moderately fat | 15g |
| Plantain | 35g |
| Papaya or orange | 50g |
| Lard | 1 - 2 tspns |
| Onion, green pepper, tomato | to flavor |

1. Cook the washed rice in about twice its volume of water, adding salt to taste.
2. Wash and cook beans with sofrito.*
3. Grind or mince the meat and cook with sofrito.
4. Boil the plantain and serve all the mixtures together.

*"Sofrito" is prepared with chopped onions, a little green pepper fried in a small amount of fat, and either fresh tomatoes or tomato paste.

(Cuba, 450 kcal)

**38. Multimix**

| | |
|---|---|
| Rice | 60g |
| Lean meat | 15g |
| Melon seeds | 5g |
| Spinach, edible portion | 60g |
| Tomato | 35g |
| Onion | 10g |
| Palm oil | 15g |
| Fish (smoked) | 15g |

1. Wash meat, add a little water and salt, and boil until almost tender.
2. Grind the melon seeds.
3. Wash the spinach well and remove the stalks. Chop the leaves.
4. Slice tomatoes and onions.
5. Heat the oil and add tomatoes, onions, and drained meat and fry for a few moments.
6. Add the meat stock and the ground melon seeds. Simmer for 10 minutes.
7. Clean the fish, cut in pieces and add with the chopped leaves to the stew.
8. Add salt to taste and serve with cooked rice.

(Ghana, 520 kcal)

**39. Multimix**

| | |
|---|---|
| Rice | 60g |
| Butter (or ghee) | 5g |
| Onion | 15g |
| Fresh ginger to flavor | |
| Lean lamb | 25g |
| Yogurt | 50g |

1. Fry the finely chopped onion in the butter or ghee.
2. Add the rice, well washed, and an equal volume of water.
3. Cook the lamb in a little water until tender and add to the cooked rice.
4. Add the meat stock and the chopped ginger.
5. Add the yogurt just before serving.

(Pakistan, 340 kcal)

**40. Multimix**

| | |
|---|---|
| Rice | 30g |
| Split peas | 10g |
| Salt pork | 5g |
| Fresh pork (lean) | 20g |
| Fat | 5g |
| Tomato | 10g |
| Onion | 10g |
| Lettuce | 5g |
| Carrots | 20g |
| Banana | 60g |

1. Cook peas and fresh pork in boiling, salted water.
2. Remove pork and fry it in a small amount of fat with onions and tomatoes.
3. When peas are almost cooked, add rice and salt pork. Cook until all water is absorbed and grains are soft.
4. Prepare lettuce and carrots as a salad.
5. Serve with pork, rice, and pea mixture.
6. Serve banana for dessert.

(Barbados, 375 kcal)

**41. Multimix**

| | |
|---|---|
| Rice | 50g |
| Green, leafy vegetable | 40g |
| Lean pork | 25g |
| Vegetable oil | 10g |
| Garlic, soy sauce, onions to taste | |

1. Wash rice and cook gently until all water is absorbed. Season with soy sauce.
2. Mince 1 clove of garlic and brown lightly in the oil. Add the chopped pork and cook gently. Wash the green vegetables and chop. Add to the pork with a little water, salt to taste, and chopped onions. Cover and cook until soft. Serve with rice.

(Malaysia, 360 kcal)

**42. Multimix**

| | |
|---|---|
| Rice | 40g |
| Mung beans, green | 20g |
| Dark-green leaves | 20g |
| Lean pork (minced or ground) | 25g |
| Tomatoes | 50g |
| Fat | 5g |

1. Wash rice and cook gently in approximately 3 times its volume of water until all water is absorbed and the rice is soft.

2. Wash the mung beans and boil until just soft. Mince 1 clove of garlic and brown lightly in some fat, add the pork, and cook until just brown. Add the chopped tomatoes and cook a little more. Add the cooked beans and enough boiling water to get the right consistency. Drop in the washed, green leaves. Cover, bring back to a boil and cook quickly. Add salt to taste and serve hot with the rice.

(Philippines, 370 kcal)

**43. Multimix**

| | |
|---|---|
| Rice, parboiled | 50g |
| Red dhal (lentils) | 15g |
| Dried fish (sprats) | 10g |
| Dark-green leaves | 30g |
| Coconut oil | 5g |
| Coconut, coconut milk | |
| Chopped onion | |
| Banana or ripe plantain, skinned | 60g |

1. Soft-boil the rice in about twice its volume of water.
2. Wash lentils and boil with a little water to which a pinch of salt and 2 tablespoons of coconut milk has been added. Cook until soft.
3. Boil the dried fish with 2 tablespoons of coconut milk. Add a little chopped onion and a pinch of salt.
4. Wash and shred the leaves and steam them in a pan with a little grated coconut. Flavor with the coconut oil and add condiments to taste.
5. Serve the banana or ripe plantain separately.

(Sri Lanka, 410 kcal)

## MILLED/SORGHUM

*(See Note, p. 128)*

### DOUBLE MIXES

**ADD 10g oil or 5g oil and 10g sugar or 20g sugar**

**TO: 60g millet/sorghum and 30g egg**

| | |
|---|---|
| 60g | 15g dried skimmed milk |
| 45g | 20g dried whole milk* |
| 70g | 25g fresh fish* |
| 65g | 25g chicken/lean meat |
| 55g | 15g soybean* |

***or** its equivalent

See also notes in Chapter 12.

Each mix provides about 350 kcal.

75g millet/sorghum and 10g legume with 5g oil **or** 10g sugar provide about the same energy and protein value.

One double mix could be (200 kcal):

| | |
|---|---|
| Sorghum flour | 50g (½ milk tin) |
| Powdered white fish | 5g (1 heaped tspn) |
| Tomato | 30g (½ small tomato) |

1. Boil some salted water.
2. Add the powdered fish and simmer for some time.
3. Add the sorghum flour and stir well.
4. Simmer for another 15 to 20 minutes.
5. Serve the tomato separately.

**44. Double mix**

| | |
|---|---|
| Millet meal | 60g |
| Skimmed-milk powder | 15g |
| Sugar | 20g |

1. Mix millet to a paste with a little water.
2. Add more water and bring to a boil.
3. Cook gently, stirring constantly, until the mixture thickens.
4. Mix in the skimmed-milk powder.
5. Cook for a further 30 minutes.
6. Add sugar to taste.

(Uganda, 350 kcal)

**45. Multimix**

| | |
|---|---|
| Sorghum flour | 35g |
| Field-pea flour | 10g |
| Fenugreek (soaked overnight) | 5g |
| Oil | 5g |
| Sugar | 5g |

1. Mix sorghum, pea flour, and soaked fenugreek with water.
2. Bring to a boil, stirring frequently.
3. Add oil and sugar.
4. Cook gently for 15 minutes. Add salt to taste.

(Ethiopia, 295 kcal)

**46. Multimix**

| | |
|---|---|
| Sorghum flour (Jowar) | 30g |
| Rice (parboiled) | 25g |
| Chick-pea flour | 10g |
| Green leaves | 30g |
| Vegetable oil | 5g |
| Milk (buffalo) | 100 ml |
| Banana, skinned | 45g |

1. Wash rice and cook in an amount of water that will be absorbed when rice is cooked.
2. Prepare a vegetable sauce using the chick-pea flour, green leaves, and oil with some flavorings of garlic, salt, and mustard, or fenugreek seeds. Serve with rice.
3. Mix sorghum flour with a pinch of salt and some water to make a dough. Roll out and bake into a roti.
4. Mash banana, mix with milk, and serve with the roti.

(India, 425 kcal)

## MAIZE (CORN)

*(See Note, p. 128)*

DOUBLE MIXES

ADD: 10g oil **or** 5g oil and 10g sugar **or** 20g sugar

| TO: | | | |
|---|---|---|---|
| | 65g maize | and | 25g egg |
| | 60g | | 15g dried skimmed milk |
| | 40g | | 25g dried whole milk* |
| | 70g | | 20g fresh fish* |
| | 65g | | 35g chicken/lean meat |
| | 50g | | 25g soybean* |

***or** its equivalent

See also notes in Chapter 12.

Each mix provides about 350 kcal.

55g maize and 35g legume with 5g oil **or** 10g sugar provide about the same energy and protein value.

One double-mix recipe could be (350 kcal):

| | |
|---|---|
| Maize meal | 65g (1 Arabian coffee cup) |
| Egg | 25g (1 small egg) |
| Sugar | 10g (1 heaped tspn) |
| Oil | 5g (1 heaped tspn) |
| Water to cook | |

1. Mix meal to a paste with a little cold water.
2. Bring the rest of the water to a boil.
3. Add the maize-meal paste and stir until cooked and thickened.
4. Remove from the fire.
5. Add the egg.
6. Beat well until thick and creamy.
7. Feed to the infant from a spoon.

**47. Double mix**

| | |
|---|---|
| Corn | 75g |
| Black kidney beans | 50g |
| Onion | 1/2 |
| Garlic to taste | |

1. Clean beans well and boil with garlic and onion.
2. After 2 hours, when beans are soft and "blown out," add salt.
3. Serve with the tortilla, prepared traditionally.

(Guatemala, 425 kcal)

**48. Double mix**

| | |
|---|---|
| Maize flour | 60g |
| Skimmed-milk powder | 15g |
| Sugar | 10g |

1. Combine maize flour and skimmed-milk powder in a pot.
2. Mix with some water into a smooth paste.
3. Add the remainder of the water and bring to a boil.
4. Cook gently for 45 minutes, stirring constantly.
5. Add sugar for flavor, and salt, if desired.

(Uganda, 310 kcal)

**49. Double mix**

| | | |
|---|---|---|
| Dry corn | 40g | |
| Lard | 10g | |
| Lean pork | 30g | |
| Tomato (1) | 30g | for sauce |
| Chillies | | |

1. Cook corn in lime water, then wash thoroughly.
2. Grind corn and boil in a little water, adding lard and salt.
3. Cut pork in small pieces and cook with seasonings.
4. Grind tomatoes and chillies together for sauce.
5. Place 2 tablespoons corn mixture in a moistened corn husk. Add a piece of meat and a spoonful of sauce.
6. Roll the husk and tie at the top.
7. Steam in a small amount of water for 1 hour (approx.)
8. Discard husk and serve mixture as a snack.

(If fat pork is used, calories are increased but protein value is decreased.)

(Guatemala, 350 kcal)

**50. Multimix**

| | |
|---|---|
| Maize meal (60% ext.) | 50g |
| Milk, whole cow's | 100g |
| Sugar | 10g |
| Groundnuts | 25g |

1. Mix the maize meal with the water to make a thin paste. Bring to a boil and cook gently until the mixture becomes smooth and thickens.
2. Toast the groundnuts gently, remove and discard the skins, and grind the nuts to a paste. Add to the maize mixture, stir well, and cook for a few minutes.
3. Remove the mixture from the fire, stir in the sugar and milk, and serve.

(Tanzania, 425 kcal)

**51. Multimix**

| | |
|---|---|
| Corn for tortilla | 35g |
| Black beans | 20g |
| Soft cheese | 20g |
| Mexican pepper, cuaque pepper | |
| Fat | 10g |

1. Toast and fry tortilla until crisp.
2. Spread fried bean paste on it.
3. Prepare a sauce of cooked, strained peppers and pour over the beans.
4. Sprinkle with cheese.

(Guatemala, 300 kcal)

**52. Multimix**

| | |
|---|---|
| Maize flour (60% ext.) | 50g |
| Cowpeas | 30g |
| Groundnuts | 15g |
| Egg (if available) | 15g |

1. Mix the maize meal with water to make a thin paste. Bring to a boil, stirring constantly, and then cook gently until the paste is smooth and light. Transfer the paste to a dish.
2. Cook the cowpeas, which have been soaked until they are soft.
3. Toast the groundnuts, remove and discard the skins, and grind nuts into a paste. Add to the cooked cowpeas. Season with salt and, if available, add a beaten egg. Serve this soup with the cooked maize paste.

(Tanzania, 390 kcal)

**53. Multimix**

| | |
|---|---|
| Maize flour | 40g |
| Bean flour | 40g |
| Dry crayfish powder | 10g |
| Palm oil, red | 10g |

1. Mix bean flour, fish powder, and warm palm oil to a smooth paste. Pour into a tin or wrap in leaves, and steam for about 1 hour.
2. Mix the maize flour into a paste with a little water. Add boiling water and mix again to a smooth paste. Cook until it thickens. Shape the thick porridge and serve with the bean cake. Salt and a small amount of chopped or ground pepper may be used to flavor the bean cake.

(Nigeria, 430 kcal)

**54. Multimix**

| | |
|---|---|
| Maize, edible portion (for koko) | 50g |
| Cowpeas | 50g |
| Smoked fish | 10g |
| Onion | 10g |
| Salt | |
| Palm oil, red | 5g |
| Leaves for molds | |

1. Pick over beans and soak overnight. Remove skins and wash beans well.
2. Grind beans to a smooth paste.
3. Grind onion.
4. Add onion to bean paste and mix.
5. Add palm oil, pounded fish, and salt to taste.
6. Add enough boiling water to soften paste.
7. Put paste into molds or wrap in leaves.
8. Arrange on pieces of stick placed in boiler and cover with leaves.
9. Steam for 1 hour.
10. Serve hot with thick maize porridge (koko)

(Ghana, 420 kcal)

**55. Multimix**

| | |
|---|---|
| Maize flour (60% ext.) | 50g |
| Onion | 40g |
| Ghee | 5g |
| Beef, lean | 20g |
| Kidney beans | 15g |
| Dark-green leaves | 60g |
| Tomato | 60g |
| Orange | 80g |

1. Porridge: bring 1-1½ cups water to a boil. Add salt and maize flour. Stir until thick. Simmer gently until cooked and serve with the beef stew.
2. For stew: peel and chop onion and fry in hot ghee until brown. Add the meat and salt to taste. Cover and let the meat cook slowly. Wash the leaves and tomatoes and fry with the meat for the last few minutes of cooking.
3. Serve orange at end of meal.

(East Africa, 340 kcal)

## TEF

*(See Note, p. 128)*

**56. Multimix**

| | |
|---|---|
| White tef | 80g (2 sini) |
| Chick-pea flour | 20g (1 small sini) |
| Kale | 30g (about 5 leaves) |
| Oil | 5g (1 tspn) |
| Sugar | 5g (1 tspn) |

1. Prepare injera from tef.
2. Mix pea flour with water and oil and boil gently together for about 10 minutes.
3. Add the mashed, chopped kale and boil another 10 minutes.
4. Add injera, sugar, and salt.

(Ethiopia, 4[illegible] kcal)

**57. Multimix**

| | |
|---|---|
| White tef | 40g (1 sini) |
| Chick-pea flour | 10g (1 Tbspn, shaken level) |
| Egg | 10g |
| Lemon juice | |
| Oil | 10g |
| Sugar | 5g |

1. Mix tef and pea flour with oil, sugar, and water. Boil gently for 20 to 30 minutes.
2. Stir in the egg.
3. Add lemon juice before serving.

(Ethiopia, 310 kcal)

## POTATO

*(See Note, p. 128)*

**DOUBLE MIXES**

**ADD: 10g oil or 5g oil and 10g sugar or 20g sugar**

| TO: | 300g potato | and | 25g egg |
|---|---|---|---|
| | 280g | | 15g dried skimmed milk |
| | 220g | | 20g dried whole milk* |
| | 310g | | 25g fresh fish* |
| | 300g | | 25g chicken/lean meat |
| | 250g | | 20g soybean* |

***or** its equivalent

See also notes in Chapter 12.

Each mix provides about 350 kcal.

320g potato and 20g legume with 5g oil **or** 10g sugar provide about the same energy and protein value.

Many other recipes using the quantities of ingredients shown here could be designed, using a selection of the available local foods.

**58. Multimix**

| | |
|---|---|
| Potato, edible portion | 200g (2 large potatoes) |
| Chick-pea flour | 30g (1 small sini) |
| Kale | 40g (about 5 leaves) |
| Oil | 5g (1 tspn) |

1. Peel potato and cut in pieces. Add mashed, coarsely chopped kale on top.
2. Boil in water until potato is soft.
3. Drain off water and use to cook the chick-pea flour.
4. Mash the potato and kale finely.
5. Add to the chick-pea mixture with more water, if necessary.
6. Add salt to taste and simmer until mixture is smooth and soft.

(Ethiopia, 325 kcal)

**59. Multimix**

| | |
|---|---|
| Potatoes | 65g |
| Veal, moderately fat | 15g |
| Carrots | 45g |
| Spinach | 45g |
| Butter or oil | 5g |
| Milk | 100g |
| Rice or rice flour | 30g |
| Sugar | 20g |

1. Fry the meat in the hot fat until brown. Wash and prepare the potatoes and carrots and add to the meat with a little water. Cook gently and, when nearly done, add the spinach, which has been washed and chopped. Season with salt, cook for a few minutes, and serve.
2. Add the sugar to the milk and bring to a boil. Mix the rice flour with a little water and add to the milk. Cook gently and serve after the stew. This is called "muhallebi."

(Turkey, 400 kcal)

**60. Multimix**

| | |
|---|---|
| Potatoes | 120g |
| Milk, cow's | 50g |
| Fish, fresh sea, fillet | 30g |
| Spinach | 60g |
| Butter | 10g |
| Spaghetti | 15g |
| Carrots | 10g |
| Oranges | 80g |
| Sugar | 10g |

1. Wash and peel the potatoes. Wash the spinach and cut up the fish. Cook together in a little salted water until the potatoes are soft. Remove the potatoes, mash them with the butter and the milk. Serve with the fish and spinach.
2. Prepare the carrots and put into boiling, salted water. Add the spaghetti and continue cooking until soft. Serve as a soup.
3. Prepare a drink with the orange juice and sugar.

(Peru, 400 kcal)

## SWEET POTATO

*(See Note, p. 128)*

ADD: 10g oil **or** 5g oil and 10g sugar **or** 20g sugar

| TO: | | and | |
|---|---|---|---|
| | 180g sweet potato | | 35g egg |
| | 175g | | 20g dried skimmed milk |
| | 100g | | 30g dried whole milk* |
| | 210g | | 35g fresh fish* |
| | 180g | | 35g chicken/lean meat |
| | 150g | | 25g soybean* |

***or** its equivalent

See also notes in Chapter 12.
Each mix provides about 350 kcal.
125g sweet potato and 50g legume with 5g oil **or** 10g sugar provide about the same energy and protein value.

**61. Multimix**

| | |
|---|---|
| Sweet potatoes, edible portion | 120g |
| Kidney beans | 40g |
| Soybeans | 40g |
| Tomatoes | 25g |

1. Soak the beans, separately, overnight.
2. Boil in clean water until soft.
3. Mash and sieve the beans and throw away the skins and fibrous parts.
4. Cook tomatoes in a small amount of water. Strain them and add the pulp to the beans.
5. Boil together for a few minutes. Add salt to taste.
6. Boil the sweet potatoes in salted water until soft.
7. Serve with the bean and tomato mixture.

(Uganda, 430 kcal)

**62. Multimix**

| | |
|---|---|
| Sweet potato | 30g |
| Yam | 30g |
| Taro (cocoyam) | 40g |
| Plantain | 30g |
| Coconut cream | 40g |
| Fish, fresh sea, fillet | 30g |
| Spinach (dark-green leaves) | 50g |
| Papaya | 100g |

1. Peel and prepare the yam and taro. Cook together with a little water, together with the peeled sweet potato and plantain.
2. Cook the spinach on top of the root vegetables.
3. Cook the fish in a little water with some onion or garlic for flavor.
4. Serve the vegetables and fish with the coconut cream prepared with ½ pint of water and with lime juice and salt added for flavor.
5. Serve the papaya fresh, as a dessert.

Alternatively, the vegetable ingredients and the fish can be baked together in the oven or a special "Tahitian" oven.

(Tahiti, 400 kcal)

**63. Multimix**

| | |
|---|---|
| Sweet potato | 100g |
| Fish, fresh sea, fillet | 20g |
| Dark-green leaves | 60g |
| Coconut, shredded | 50g |
| Bananas | 60g |

1. Prepare the coconut milk.
2. Peel the sweet potatoes, cut in pieces, and put in a pot with half the coconut milk and a small amount of water and a little salt. Cook until soft (about 20 minutes). Serve as such or mash with any leftover cooking liquid.
3. Wash leaves (taro or sweet potato tops), cut in pieces and put in a pot with the rest of the coconut milk, a little water, salt and a little onion for added flavor. Cook gently for about 20 minutes.
4. Wash the fish, remove any visible bones, and place on top of the vegetables. Continue cooking for another 10 minutes. When cooked, serve with the sweet potato. All fluids should be absorbed during cooking.
5. Banana is served at the end of the meal.

(Tonga, 420 kcal)

**64. Multimix**

| | |
|---|---|
| Sweet potato, edible portion | 60g |
| Yam, edible portion | 60g |
| Potato, edible portion | 60g |
| Salted beef | 20g |
| Salted fish or flying fish | 30g |
| Tomato | 40g |
| Onion | 20g |
| Sugar | 10g |
| Lemon or lime juice and water | |

1. Steam together the salted fish, tomato, and onion.
2. Boil together the yam, sweet potato, potato, and salted beef.
3. Serve together.
4. Make a drink of the lemon juice, sugar, and water.

(Barbados, 310 kcal)

**65. Multimix**

| | |
|---|---|
| Sweet potato | 60g |
| Lean beef | 15g |
| Melon seeds for egusi | 5g |
| Spinach, edible portion (dark-green leaves) | 120g |
| Tomato | 35g |
| Onion | 30g |
| Palm oil, red | 15g |
| Fish, smoked dried | 10g |

1. Wash beef, add a little water and s[illegible] and boil until tender.
2. Grind melon seeds. Wash and chop the spinach leaves.
3. Heat palm oil and add sliced tomato and onion.
4. Add drained meat and fry a few minutes.
5. Add meat stock and the egusi. Simmer 10 minutes. Add chopped green leaves.
6. Clean the fish, cut into pieces, and add to the stew.
7. Add salt to taste and serve with cooked sweet potato.

(Ghana, 400 kcal)

## DOUBLE MIXES

ADD: 10g oil **or** 5g oil and 10g sugar **or** 20g sugar

| TO: | 220g yam | and 25g egg |
|---|---|---|
| | 190g | 15g dried skimmed milk |
| | 115g | 30g dried whole milk* |
| | 240g | 35g fresh fish* |
| | 210g | 35g chicken/lean meat |
| | 175g | 20g soybean* |

***or** its equivalent

See also notes in Chapter 12.

Each mix provides about 350 kcal.

165g yam and 40g legume with 5g oil **or** 10g sugar provide about the same energy and protein value.

One double mix, could be (315 kcal):

| | |
|---|---|
| Yam, edible portion | 240g |
| Powdered fish | 15g (1 Tbspn) |
| Palm oil, red | 10g (2 tspn) |
| Water to cook | |
| Salt to taste | |

1. Put small pieces of peeled and cut-up yam into a pot and just cover with water. Add salt to taste.
2. Bring to a boil and add the powdered fish.
3. Cook gently until yam is soft.
4. Remove any surplus water.
5. Mash yam and beat in the oil.
6. Feed the infant from a spoon.

**66. Double mix**

| | |
|---|---|
| Yam, edible portion | 150g |
| Egg (1 small) | 30g |
| Palm oil, red | 15g |

1. Wash, peel, and slice yam, then wash again.
2. Boil water and salt in a pot.
3. Add yam and egg (in shell) and cook for 15 minutes.
4. When yam is cooked, strain off water and remove egg.
5. Mash yam finely in a bowl, add oil, and mix well.
6. Mold the mixture in a bowl and make hole in center of mixture.
7. Discard egg-shell and put egg into the hole.
8. Serve.

(Ghana, 340 kcal)

**67. Multimix**

| | |
|---|---|
| Yam, edible portion | 60g |
| Garden egg (eggplant), 2 | 100g |
| Okras, 2 | 30g |
| Tomato, 1 | 50g |
| Powdered fish | 10g |
| Palm oil, red | 20g |

1. Wash eggplants, okras, and tomato and cut into small cubes.
2. Put in pot, cover with boiling water, and add salt.
3. Bring to a boil again, simmer until tender, then mash finely.
4. Return to pot, add fish, yam cut in cubes, and liquid if necessary.
5. Simmer until yam is soft.
6. Add palm oil and mix well.
7. Serve to toddler.

(Ghana, 370 kcal)

**68. Multimix**

| | |
|---|---|
| Yam | 100g |
| Crayfish powder | 15g |
| Tomatoes | 90g |
| Palm oil, red | 10g |
| Spinach | 100g |
| Banana | 90g |

1. Peel, wash, and slice yam, and boil gently with just enough water to cover until almost soft.
2. Add the chopped tomatoes and crayfish powder.
3. Wash and chop the spinach, add it to the pot and simmer gently until all foods are tender.
4. Stir in the palm oil and mix thoroughly before serving.
5. The banana may be served after the meal.

(West Africa, 450 kcal)

## TARO/COCOYAM/DASHEEN

*(See Note, p. 128)*

### DOUBLE MIXES

ADD: 10g oil **or** 5g oil and 10g sugar **or** 20g sugar

| TO: | | and | |
|---|---|---|---|
| | 190g taro/cocoyam | | 25g egg |
| | 180g | | 15g dried skimmed milk |
| | 115g | | 25g dried whole milk* |
| | 220g | | 40g fresh fish* |
| | 195g | | 30g chicken/lean meat |
| | 150g | | 20g soybean |

***or** its equivalent

See also notes in Chapter 12.

Each mix provides about 350 kcal.

150g taro/cocoyam and 45g legume with 5g oil **or** 10g sugar provide about the same energy and protein value.

**69. Double mix**

| | |
|---|---|
| Cocoyam, edible portion | 220g |
| Clear palm oil | 10g |
| Powdered fish | 15g |

1. Wash and peel the cocoyam, then wash it again.
2. Cut into small pieces and place in pot.
3. Cover with bone stock or water and add salt.
4. Bring to a boil and add powdered fish.
5. Lower heat and allow to cook until cocoyam is soft.
6. Pour off any surplus stock and mash the cocoyam finely.
7. Add palm oil and mix well.

(Ghana, 360 kcal)

**70. Double mix**

| | |
|---|---|
| Cocoyam, edible portion | 195g |
| Clear palm oil | 10g |
| Lean meat | 30g |

1. Wash and peel the cocoyam, then wash it again.
2. Cut into small pieces and place in pot.
3. Cover with bone stock or water and add salt.
4. Add chopped meat.
5. Bring to a boil and cook gently until meat is tender.
6. Mash finely with a wooden spoon.
7. Add palm oil and mix well.

(Ghana, 350 kcal)

## BANANA

*(See Note, p. 128)*

### DOUBLE MIXES

ADD: 10g oil **or** 5g oil and 10g sugar **or** 20g sugar

| TO: | | and | |
|---|---|---|---|
| | 190g banana | | 30g egg |
| | 165g | | 20g dried skimmed milk |
| | 100g | | 30g dried whole milk* |
| | 210g | | 40g fresh fish* |
| | 185g | | 40g chicken/lean meat |
| | 140g | | 25g soybean* |

***or** its equivalent

See also notes in Chapter 12.

Each mix provides about 350 kcal.

105g banana and 55g legumes with 5g oil **or** 10g sugar provide about the same energy and protein value.

Banana does not increase in bulk if boiled or steamed. If ripe, it can be mashed finely and eaten raw.

One double mix could be (140 kcal):

| | |
|---|---|
| Banana, skinned | 60g (1 small banana) |
| Evaporated milk (unsweetened) | 30g (2 Tbspns) |
| Sugar | 5g (1 tspn) |
| Salt to taste | |

1. Slice banana into a bowl and mash until it is free of lumps.
2. Mix in milk, sugar, and salt to taste to make a smooth cream.
3. Feed to the infant from a spoon.

### 71. Multimix

| | |
|---|---|
| Banana, skinned (just ripe) | 120g |
| Groundnuts roasted lightly, skinned, and ground | 35g |
| Skimmed-milk powder | 15g |

1. Make a paste of the groundnuts and some water.
2. Beat skimmed-milk powder into the rest of the water until smooth.
3. Boil the mixture gently for 1 to 1½ hours, salt to taste.
4. Peel banana, just cover with water in a saucepan, and boil for 30 minutes or until done.
5. Drain off water and mash banana.
6. Serve with the first mixture.

(Uganda, 365 kcal)

**72. Multimix**

| | |
|---|---|
| Banana, skinned | 100g |
| Coconut, fresh, grated | 50g |
| Egg (1/2, beaten) | 20g |
| Evaporated milk | 20g |

1. Slice banana and mash in bowl until it is free of lumps.
2. Add coconut, beaten egg, and milk.
3. Mix to a smooth consistency.
4. Place in a greased tin and steam over boiling water until set.

(Nigeria, 390 kcal)

## PLANTAIN

*(See Note, p. 128)*

### DOUBLE MIXES

ADD: 10g oil **or** 5g oil and 10g sugar **or** 20g sugar

| TO: | | and | |
|---|---|---|---|
| | 150g plantain | | 45g egg |
| | 150g | | 20g dried skimmed milk |
| | 90g | | 30g dried whole milk* |
| | 180g | | 45g fresh fish* |
| | 160g | | 45g chicken/lean meat |
| | 115g | | 30g soybean* |

***or** its equivalent

See also notes in Chapter 12.

Each mix provides about 350 kcal.

85g plantain and 55g legume with 5g oil **or** 10g sugar would provide about the same energy and protein value.

Plantain does not increase in bulk when boiled or steamed.

One double mix could be (164 kcal):

| | |
|---|---|
| Plantain, edible portion | 50g (1/4 - 1/2 plantain) |
| Fish (no bones) | 10g (1 Tbspn fresh) |
| Oil | 10g |

1. Cut plantain into small pieces and wrap up in a banana leaf with the fish and a little water. Tie leaf carefully.
2. Steam the food for 2 to 2½ hours.
3. Open the leaves and mash up the cooked plantain and fish with oil before feeding to the infant.

Only one other recipe is given: mixes can be designed for plantain by using it with other local foods in the quantities suggested.

73. **Multimix**

| | |
|---|---|
| Plantain, edible portion | 40g |
| Bambara groundnuts | 60g |
| Dried shrimps | 10g |
| Onion | 20g |
| Peppers and salt to taste | |
| Palm oil, red | 5g |

1. Soak beans overnight; change water the next day.
2. Simmer beans until tender (2½ hours).
3. Fry peppers, onion, and shrimps together in the oil.
4. Mash beans and pile on plate.
5. Add shrimp mixture, mashed as necessary.
6. Serve with roasted plantain.

(Ghana, 340 kcal)

## CASSAVA FLOUR

*(See Note, p. 128)*

### DOUBLE MIXES

ADD: 10g oil **or** 5g oil and 10g sugar **or** 20g sugar

| TO: | | | |
|---|---|---|---|
| | 60g cassava flour | and | 50g egg |
| | 60g | | 20g dried skimmed milk |
| | 35g | | 30g dried whole milk* |
| | 75g | | 50g fresh fish* |
| | 70g | | 45g chicken/lean meat |
| | 50g | | 30g soybean* |

**or** its equivalent.

See also notes in Chapter 12.

Each mix provides about 350 kcal.

A mix with legumes in any proportion would be impractical if the same energy and protein value were to be achieved (see note b, Table 17b).

Cassava flour increases in bulk as it is cooked in water, but the fresh root does not. The following are examples of recipes for mixes using cassava flour.

74. **Multi...ix**

| | |
|---|---|
| Cassava flour | 20g |
| Black beans | 60g |
| "Louro" leaf | |
| Beef | 30g |
| Fat for frying | 10g |

1. Boil beans with louro leaf and seasonings until soft.
2. Add cassava flour and continue cooking until it looks like brown porridge.
3. Fry the meat in the fat, or use roasted meat. Serve foods together.

(Brazil, 390 kcal)

**75. Multimix**

| | |
|---|---|
| Cassava, edible portion | 60g |
| Meat | 40g |
| Apon (wild mango kernel) | 25g |
| Tomatoes | 15g |
| Onion | 10g |
| Red pepper and fermented locust bean to taste | |
| Dried crayfish | 5g |
| Palm oil, red | 5g |

1. Cut meat into small pieces, add about 1 cup water, and boil gently until nearly tender.
2. Pound apon to a fine paste and grind together the tomato, onion, red pepper, and locust bean.
3. Add another cup of water and the oil to the meat, bring to a boil, and add remaining ingredients.
4. Continue cooking for ½ hour. Season with salt.
5. Serve with stiff cassava porridge (foofoo).

(Nigeria, 440 kcal)

## RECIPE NUMBERS LISTED ACCORDING TO REGIONS

### AFRICA

| | |
|---|---|
| East Africa | 55 |
| West Africa | 68 |
| Ethiopia | 8, 45, 56, 57, 58 |
| Gambia | 20, 35 |
| Ghana | 38, 54, 65, 66, 67, 69, 70, 73 |
| Nigeria | 15, 53, 72, 75 |
| Sierra Leone | 7, 17, 24, 25 |
| Tanzania | 50, 52 |
| Uganda | 44, 48, 61, 71 |

### THE AMERICAS

| | |
|---|---|
| Barbados | 33, 40, 64 |
| Brazil | 74 |
| Caribbean | 36 |
| Cuba | 37 |
| Guatemala | 21, 47, 49, 51 |
| Peru | 60 |

### EASTERN MEDITERRANEAN

| | |
|---|---|
| Egypt | 3, 4, 9, 10 |
| Iran | 12 |
| Jordan | 19 |
| Morocco/Algeria | 13, 18 |
| Syria | 14 |

### EUROPE

| | |
|---|---|
| Turkey | 5, 59 |

### SOUTH EAST ASIA

| | |
|---|---|
| Sri Lanka | 43 |
| India/Pakistan | 1, 2, 6, 11, 16, 22, 23, 39, 46 |

### WESTERN PACIFIC

| | |
|---|---|
| Indonesia | 30 |
| Korea | 26, 27, 28 |
| Malaysia (Chinese) | 29, 34, 41 |
| Philippines | 31, 42 |
| Tahiti | 62 |
| Thailand | 32 |
| Tonga | 63 |

# Chapter 16

# Outline Plan for a Local Edition

It should not be difficult to organize a local edition of this manual by extracting those sections that have direct application to conditions and food supplies in a particular region or locality. Such an edition should be written in simple language, using short words and sentences. It should state clearly both the procedures and the reasons for using them. Some local words might be included to describe customs, utensils, measures, or foods, as long as any new auxiliary worker who comes to work in the area can understand them. Simple line drawings are helpful for illustrating a food, a measure, a utensil, or even a weight chart.

The local edition should give some background information, but most of the pages should be devoted to direct instructions. Assistance in preparing and producing such an edition might come from a regional nutrition institute, a senior person in the medical field already familiar with the region and its problems, a nutritionist-dietitian, a senior home economist, or a department of food science and technology. Assistance might also be sought from personnel in the appropriate United Nations Agency.

The local edition could be divided into the following parts:

1. *The aim of the manual and for whom it is intended.*

2. *The reason improved nutrition is necessary.* An introduction can explain simply some of the local health statistics. These might include mortality rates, the incidence of the most common infections, differences in heights and weights of local children when compared with well-fed children in the same country, specific local nutritional problems, and why these occur.

3. *The people in the area.* For personnel from other regions, especially, include a brief account of the people themselves: how they live; their family structure and patterns of authority; common beliefs about food and infant-feeding customs; marketing facilities; transport systems; and community facilities.

4. *The local foods.* A description of the important local foods is essential, and should include the variety available and the contribution these make to the local diet in terms of energy and other nutrients. Emphasis should be placed on foods that are particularly valuable for infant and child feeding. This section could be adapted from Chapter 6 in this manual.

5. *Local processing methods*. This section could be adapted from Chapter 7. Discuss local methods of preparing, cooking, and serving food to show what effect these processes have on food nutrients, particularly those most often used. Emphasize the local methods which are good and should be encouraged; point out those which decrease nutrient values.

6. *Handling of food and utensils*. Review local customs of handling and storing food in order to show how food can become contaminated or wasted through spoilage. Point out the effects contamination might have on infants and children. Suggestions for improvements can be taken from this manual and adapted for local conditions.

7. *Meal patterns*. Include some details of existing practices of feeding infants and young children to show how these affect growth and development: the family meal pattern and number of meals eaten each day; whether food is cooked at home or purchased from food vendors; whether snack meals are important; and whether the family eats together from a communal plate or everyone has an individual bowl. State clearly those methods and customs to be encouraged.

8. *Breast-feeding*. Emphasize strongly the advantages of breast-feeding in the lower income groups and the difficulties and dangers that may be associated with bottle-feeding. Select suggestions for supplementary feedings from this manual and base them on the local foods. The mixes should be listed in two groups: (1) suitable as supplements to breast milk or bottle-feedings; (2) meals to give when the milk becomes the supplement. Include information on the ages for which these foods are suited, how often they should be fed, and in what quantities. Also include the hygienic aspects of food preparation.

9. *Breast-milk substitutes*. Give clear instructions for substitute feeding. These should be based on what is available locally at a reasonable price. Fresh cow's milk (see Tables 15a and 15b) or a manufactured milk powder might be recommended. Amounts to be given, frequency of feeding, and the way meals should be fed also should be included. If supplementary foods are available for distribution to mothers and young children from a clinic or center, give precise instructions on how they should be used.

10. *Improvement of meals*. Examples of recommended meals can be taken from appropriate sections in this manual. They should be based on the local staple foods, and the local information that has been collected will dictate the best examples to use. Any recommendations made must be within the economic means of the families, their available household resources, and the time the mother has to prepare food.

11. *Record-keeping*. The records to be kept and systems of keeping them should be made simple and clear. Specific instructions are needed to insure that the right kind of information is collected in a useful form. These records will act as baseline evidence, and will be required later to measure the improvements that have taken place.

12. *Education*. Define exactly what facts must be taught in the community. They should be part of an over-all plan for the country or region. They should be

precise, follow in logical sequence, and deal primarily with local problems. All teaching should be in terms of local conditions, foods, measures, and methods at the community's social and economic level, and they should always be related to health. Some guidelines can be found in this manual.

Suggest where the teaching can best be done--in a health clinic, a community center, at a community gathering on market day, or elsewhere. List the facilities and aids available for teaching and where they can be obtained.

Discuss who should do the teaching and who might be asked to assist or complement the teaching in the agricultural or community-development fields.

A step-by-step account of how one demonstration might be prepared, given, and followed up could be included as an example.

## APPENDIX A

### A SIMPLE METHOD FOR CALCULATING THE PROTEIN VALUE OF A FOOD OR MIX IN TERMS OF A REFERENCE PROTEIN

*Quantity of protein.* In practical dietary work, the quantity of protein in a food may be found in standard food-composition tables. It can be expressed (in terms of its energy) as a percentage of the total energy present in the food. For example:

| | | |
|---|---|---|
| Protein in a food | = | 5g, or 20 kcal (5 x 4) |
| Total energy in food | = | 200 kcal |
| Protein quantity | = | $\frac{20}{200} \times 100$ |
| Or Protein E % (PE%) | = | 10% |

This is not equivalent to reference protein, because no allowance has been made for its quality.

*Quality of protein.* Calculation of protein quality is based on the amino-acid composition and its pattern in a food or mix. This pattern is compared with the reference pattern, which is said to be ideal for human requirements (see Chapter 5). The essential amino acid that is present in the pattern in the least proportionate amount limits the value or score of the protein. In theory, each essential amino acid in the food should be compared with the reference pattern. In practice, however, when scoring for the protein value of foods as they are eaten in meals, it has been found necessary to examine only for:

(1) sulphur-containing amino acids (methionine and cystine), or

(2) lysine, particularly when the source of protein is primarily cereal. The amino acid that gives the lowest score is the one which limits the value of the protein, and is called the limiting amino acid.

To calculate the score on the basis of a sulphur-containing amino acid (S.A.A.) being the limiting amino acid:

1. Calculate the amount of protein in the food or foods* from food-composition tables.
2. Calculate the total amount of S.A.A.** from tables that give the amount of amino acid present per gram of protein in food(s).
3. Express the total amount of S.A.A. present as a percentage of the amount in an equivalent amount of reference protein. For S.A.A. (and for lysine), this is 42mg per gram of protein.

---

*See Table 19 for some analysis figures of food composition.
**See Table 19 for useful list of amino-acid contents of most commonly used foods.

For example:

Total protein present in food(s) = 15g
Total S.A.A. present = 475mg

$$\text{Score} = \frac{475}{15 \times 42} \times 100 = 75$$

This calculated score differs slightly from one determined biologically by feeding experiments. Some allowance must be made for the fact that if protein is eaten in the diet at concentrations above a standard for maintenance, the efficiency with which it is used decreases. As the concentration of protein in a meal increases, the proportion actually used for building body tissue (anobolism) falls. This decrease is allowed for in the nomograph (Figure 30), which also corrects for it and is used to find the protein value, NDpE percentage, from calculated data.

*Use of the nomograph*

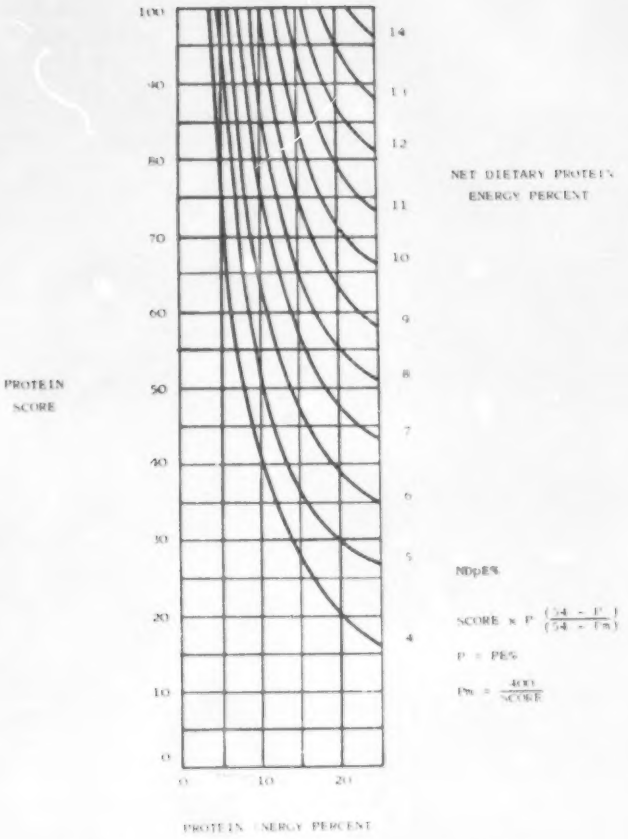
To find the NDpE percentage of a diet with a quantity factor of 15 percent and a quality factor or score of 75:

1. On the vertical axis of the nomograph, find the line for a diet with a score of 75.
2. On the lower horizontal axis, find the line for a diet with a PE percentage of 15.
3. The point at which these two lines meet cuts a curve; this is the NDpE percentage, or protein value, and is 9 percent.

If a diet has a score of 75 and a PE percentage of 12.5, the two lines meet on the 8-curve. The protein value for such a diet would be NDpE 8 percent. If the score is 70 and the PE percentage is 10, the lines meet at a point between the 6 and 7 curves, and the value is about NDpE 6.5 percent.

It is interesting to note that:

1. If the score of a diet is 50 or less, it is not possible to obtain the protein value suitable for an infant whose requirement is NDpE 8 percent.
2. Even if the score is 100, it is not possible to obtain an NDpE 8 percent if the PE percentage is below 9.
3. If the PE percentage is increased above 25 percent, the protein value will begin to fall. The reason is that, because protein normally requires 6 kcal per gram of energy for its metabolism, an increasing amount of the available protein present must be used to meet this need.




NOMOGRAPH TO OBTAIN NDpE% FROM PROTEIN SCORE AND PROTEIN ENERGY PERCENT

**Figure 30. Nomograph to find NDpE% from protein score and protein energy percentage.**

EXAMPLE OF SCORING A SIMPLE MIX FOR PROTEIN VALUE:

| | *From food tables* | | | | *Amount in ingredients* | | |
|---|---|---|---|---|---|---|---|
| Food ingredient | Weight in grams | Protein, g/100g | kcal per 100g | S.A.A. mg/g protein | Protein $\frac{A \times B}{100}$ | kcal $\frac{A \times C}{100}$ | S.A.A. mg E x D |
| | A | B | C | D | E | F | G |
| Wheat | 100 | 10 | 350 | 31 | 10 | 350 | 310 |
| Beans (blackeyed bean or cowpea) | 10 | 22 | 340 | 20 | 2.2 | 34 | 44 |
| Totals in mix | | | | | 12.2 | 384 | 354 |

*Quantity Factor (PE%)*

$$\frac{\textit{Total protein (g)} \times 4 \times 100}{\text{Total kcal}} = \frac{12.2 \times 4}{384} \times 100$$

$$\text{PE\%} = 12.7$$

*Quality Factor* (Score)

$$\frac{\text{Total S.A.A. (mg)}}{\text{Total protein g} \times 42} \times 100 = \frac{354}{12.2 \times 42} \times 100$$

$$\text{Score} = 69$$

***Protein Value*** (NDpE%) = 7.5%
(Read from nomograph)

**Investigations have shown that the protein quality in 75 to 80 percent of the meals or** diets tested has been limited by the sulphur-containing amino acids, although most cereals are themselves deficient in lysine. Because foods are not normally eaten alone, but in combination with others, the total amino-acid content of the whole meal, rather than individual ingredients, should be considered in a score.

## TABLE 19. ANALYSIS FIGURES USED IN CALCULATIONS*

| Food | Protein, g/100g | Energy mg/g protein | Limiting Amino Acids*** | |
|---|---|---|---|---|
| | | | Total S.A.A., mg/g protein | lysine, mg/g protein |
| Egg | 13 | 158 | 54 | 59 |
| Chicken | 19 | 139 | 35 | 86 |
| Fish (fresh, lean)** | 17 | 73 | 39 | 86 |
| Fish (dried, white) | 29 | 125 | 39 | 86 |
| Dried skimmed milk | 36 | 357 | 37 | 80 |
| Dried whole milk | 25.5 | 500 | 37 | 80 |
| Soybean | 35 | 382 | 30 | 64 |
| Average legume (e.g., cowpea) | 22 | 340 | 20 | 72 |
| Groundnuts (dry) | 27 | 579 | 20 | 35 |
| Wheat flour (70% extraction) | 10 | 350 | 31 | 21 |
| Rice (polished) | 7 | 352 | 32 | 25 |
| Maize (96% extraction)**** | 9.5 | 362 | 25 | 19 |
| Millet (Pennisetum) | 9 | 365 | 25 | 21 |
| Sorghum (Guinea corn) | 10 | 353 | 27 | 19 |
| Oats | 12 | 388 | 32 | 27 |
| Potato | 2 | 75 | 26 | 48 |
| Sweet potato | 1.5 | 114 | 26 | 48 |
| Taro | 2 | 113 | 26 | 48 |
| Yam (fresh) | 2 | 104 | 26 | 48 |
| Plantain | 1 | 128 | 16 | 48 |
| Banana | 1 | 116 | 16 | 48 |
| Cassava flour | 1.5 | 342 | 16 | 48 |

*Tables of representative values of foods commonly used in tropical countries. (B. S. Platt, 1962.)

**If dried, smoked fish is used as a substitute, total S.A.A. and lysine, mg/g protein, are 32 and 72 respectively.

***Values modified from Amino Acid Composition of Foods, M.L. Orr and B.K. Watt, and confirmed by biological assay at the Human Nutrition Research Unit, Mill Hill, London.

****If maize is 60% extraction, protein and energy/100 are 8.0g and 354kcal respectively.

## APPENDIX B

## GLOSSARY

**Botanical and alternative common names for ingredients used in the recipes**

| | |
|---|---|
| **STAPLES** | |
| Banana | *Musa sapientum* |
| Cassava | *Manihot esculenta* |
| Cocoyam, taro, dasheen | *Colocasia esculenta* |
| Maize corn | *Zea mays* |
| Millet: bulrush | *Pennisetum americanum* |
| finger seed | *Eleusine coracana* |
| Plantain | *Musa paradisiaca* |
| Potatoes, Irish or English | *Solanum tuberosum* |
| Rice | *Oryza sativa* |
| Sorghum, kaffir or Guinea corn, jowar | *Sorghum* spp. |
| Sweet potato | *Ipomoea batatas* |
| Wheat | *Triticum vulgare* |
| Semolina, soji | Crushed endosperm of hard wheat |
| Yam | *Discorea* spp. |
| **LEGUMES** (pulse, dried beans or peas) | |
| Bambara groundnut, jugo bean | *Voandzeia subterranea* |
| Beans, fresh string or green | Dolichos spp.; *Phaseolus* spp.; *Vigna* spp. |
| Bengal gram, chick-pea | *Cicer arietinum* |
| Broad bean, horse bean | *Vicia faba* |
| Cow pea; blackeyed bean or pea, catjang | *Vigna* spp. |
| Kidney bean; haricot, navy, or pinto bean | *Phaseolus vulgaris* |
| Lentil, dhal; split pea, red dhal | *Lens culinaris; L.esculenta* |
| Locust bean (African); oko | *Parkia* spp. |
| Mung bean; Indian bean; red bean; green or golden gram | *Phaseolus aureus* |
| Mung bean; black gram, urd | *Phaseolus mungo* |
| Pea, fresh, green; garden, field | *Pisum sativum* |
| Pigeon pea; catjang pea, red gram, yellow dhal | *Cajanus cajan* |
| Soybean | *Glycine max* |

## VEGETABLES

| | |
|---|---|
| Aubergine, eggplant, Ghana garden egg | *Solanum melongena* |
| Beetroot | *Beta vulgaris* |
| *Baobab leaves, from Cream of Tartar tree | *Adansonia digitata* |
| *Bitter leaves | *Vermonia amygdalina* |
| *Mustard leaves | (probably) *Brassica juncea* |
| *Spinach leaves | (probably) *Basella alba* |
| Lettuce | *Lactuca sativa* |
| Okra, ila, brindi, ladies fingers | *Hibiscus esculentus* |
| Louro leaf | Edible laurel leaf |

## SEEDS, PEPPER, FLAVORINGS

| | |
|---|---|
| Apon, kernel of the wild mango | *Irvingia gabonensis* |
| Dawadawa, iru, fermented African locust bean | *Parkia filicoidea* |
| Egusi, agushi, watermelon seed | *Citrillus vulgaris* |
| Ogiri | Fermented melon seeds |
| Ginger | *Zingiber officinale* |
| Neri seeds, African locust bean | *Parkia biglobosa* |
| Peppercorns, dried black berries | *Piper nigrum* |
| Peppers (green or red) | *Capsicum annuum* |
| chillies (fresh or dried) | *Capsicum frutescens* |
| Peppers (Mexican or Cuaque) | *Capsicum frutescens* or *C.annuum* |
| Sambal: a hot Indonesian sidedish made from the yellowish brown seeds of the soybeans with other ingredients | |
| Sesame seed, simsim, beniseed | *Sesamum indicum* |
| Tempe, tempeh: fermented soybean cake (Indonesian) | |

## OILS

| | |
|---|---|
| Red palm oil, epo | Contains carotene and comes from the pericarp of *Elaeis guineensis* (frequent heatings destroy the red color) |
| Clear palm oil | From the palm-nut kernel: contains no carotenes |

* All leaves with a medium carotene content, sometimes called ewedu or ajefowo.

## SPICES

| | |
|---|---|
| Cloves dried, flower buds | *Eugenia aromatica* |
| Coriander "seeds," dhania (dried ripe fruit) | *Coriandrum sativum* |
| Darchenri, cinnamon bark | *Cinnamomum zeylanicum* |
| Garam marsala, a mixture of ground spices, e.g., cloves, cardamom, and bay leaves | |
| Ilacho, alichi, cardamon minor | *Elettaria cardamomum* |
| Tezpat | Bay leaves |
| Turmeric (dry root) | *Curcuma longa* |
| Zera seed, dried ripe fruit of cumin | *Cuminum cyminum* |

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